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SPECIAL REPORT 169

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MINERAL LAND CLASSIFICATION OF THE SAN ANDREAS 15-MINUTE QUADRANGLE CALAVERAS COUNTY, CALIFORNIA

1993

By

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PREFACE

The California Surface Mining and Reclamation Act of 1975 (SMARA) requires the State Geologist to classify land according to the presence, absence, or likely occurrence of significant mineral deposits in certain areas of the state. This Special Report is one of a series of mineral land classification studies being conducted in the Western Sierra Nevada Metamorphic belt by the California Division of Mines and Geology. The information is provided to the State Mining and Geology Board for transmittal to local governments and federal agencies who regulate land use in this region

EXECUTIVE SUMMARY

The California Surface Mining and Reclamation Act of 1975 requires the State Geologist to classify land, according to the presence, absence, or likely occurrence of significant mineral deposits in certain areas of the State subject to urban expansion or other irreversible land uses incompatible with mining. The primary objective of mineral land classification is to ensure that the mineral potential of land is recognized and considered before land-use decisions which could preclude mining are made.

This report includes a geologic map of the San Andreas 15-minute quadrangle (Plate 1), and Mineral Land Classification maps which display the location of specific types of mineral deposits (Plates 2, 3, 4, 5, and 6). Summary descriptions of areas classified MRZ-2 and MRZ-3 are presented on Tables 1 through 5. Sand, gravel, and common rock resources are not addressed in this report.

Major findings of this study are:

- Two areas in the San Andreas quadrangle contain significant measured reserves of lode gold and have been classified MRZ-2a. The Mountain King – Royal Mine contains 9.07 million tons at grade of 0.070 ounces/ton; the Carson Hill Mine contains 16 million tons at a grade of 0.046 ounces/ton.
- Two areas, the Mother Lode Belt and the Big Seven Mine, are identified as containing significant inferred resources of lode gold (MRZ-2b). The gold, along with associated silver, copper, lead, and zinc, typically is present in small, but rich, pockets in hydrothermally formed quartz veins that occupy faults, fissures, and joints which cut metamorphic and igneous rock of the region. The mineralized areas occur within several northerly trending linear zones characterized by highly faulted and deformed rock, quartz veining, and talc-bearing schist. The remaining parts of these mineralized zones are identified as favorable geologic terranes for the occurrence of hydrothermally formed gold and associated metal deposits (MRZ-3a).
- One area contains significant measured and indicated reserves of talc (MRZ-2a). The Red Hill talc quarry, operated by Western Source, Inc., produces a high quality talc formed by the hydrothermal alteration of quartz mica schist.
- Three areas, the Kentucky House, Calaveritas, and Cave City deposits, have been classified as containing significant inferred resources of limestone (MRZ-2b). Historic producers of limestone for cement are all currently idle. An additional five areas are identified as being favorable geologic terranes for the occurrence of talc, limestone and silica resources (MRZ-3a).
- The area along the Foothill Copper-Zinc Belt has been classified as being a favorable geologic environment for containing economic base and precious metal deposits formed by volcanogenic processes (MRZ-3a).
- The area within the Bear Mountains serpentinite belt has been classified as being favorable terrane for the occurrence of chromite resources (MRZ-3a). Chromite has been produced from several localities within this belt as recently as the 1950's.
- Remnants of ancient river channel deposits, partly or wholly concealed by younger volcanic and sedimentary rocks, occur throughout the study area. Although extensively worked in the 1800's, and periodically since, the so-called "auriferous gravels" remain a potential source for economic deposits of placer gold. Modern river and stream beds continue to be mined for placer gold as well. Both types of river channel deposits have been classified MRZ-3a.

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PART I - MINERAL LAND CLASSIFICATION PROJECT DESCRIPTION

INTRODUCTION

Local, State, and federal agencies are faced with difficult land-use decisions as competition for land for a variety of purposes increases. Since the availability of mineral resources is vital to our society, it is essential that mineral potential of land be considered in the land-use planning process. The California Surface Mining and Reclamation Act of 1975 requires the State Geologist to classify land according to the presence, absence, or likely occurrence of significant mineral deposits in certain areas of the state. This information is provided under policies of the California State Mining and Geology Board (the Board) (1983). The Board transmits the mineral land classification information to appropriate lead agencies that are required to incorporate it in their general land-use plans. The primary objective of mineral land classification is to assure that the mineral resource potential of land is recognized and considered before land-use decisions that could preclude mining are made.

CLASSIFICATION PROCEDURES

Data Gathering and Assessment

The Western Sierra Nevada metamorphic belt region is one of several geographic regions in California to be selected for non- urban SMARA mineral land classification studies (Figure 1). This study includes the San Andreas 15-minute quadrangle which is located in the central part of California (Figure 2). The study involved research of geologic and mining related literature, compilation of geologic maps, and plotting of reported mines and prospects using publications and mine data of the Division of Mines and Geology, U.S. Geological Survey, U.S. Bureau of Mines and the Bureau of Land Management. It included a field work phase which involved a site investigation of many of the known mines and mineral prospects, limited sampling of rocks for chemical analyses, geophysical surveys, and some geologic mapping. This data was assessed in order to identify the geologic factors which control or influence mineralization.

The field and analytical data were integrated and evaluated for assigning Mineral Resource Zones (MRZs) to areas in accordance with Mineral Land Classification guidelines adopted by the California State Mining and Geology Board (1983). A geologic map (scale 1:48,000) and Mineral Land Classification maps (scale 1:48,000) were prepared and are included in this report (Plates 2-7). The maps also show mine and prospect localities. Mines and prospect descriptions are presented in Appendix A

The California Mineral Land Classification System

The State Geologist, in consultation with the State Mining and Geology Board, has adapted Mineral Resource Zone (MRZ) nomenclature and criteria to what is referred to as the California Mineral Land Classification Diagram (Figure 3). The diagram is a modification of a mineral resource classification diagram developed by the U.S. Bureau of Mines and the U.S. Geological Survey (1980) that has become a standard reference to present the relationship between the knowledge of mineral deposits and their economic characteristics. Definitions of terms used in the diagram are presented in Appendix B.

The horizontal axis of the diagram relates the degree of knowledge about mineral resource occurrence while the vertical axis relates economic characteristics of the deposits. The two major divisions on the diagram are "Identified Resources" (MRZ-2) and "Undiscovered Resources" (MRZ-3). Areas classified as MRZ-2 contain identified mineral resources and areas classified as MRZ-3 may contain undiscovered mineral resources.

Mineral Resource Zone (MRZ) Categories

Mineral Resource Zone (MRZ) categories set forth in the guidelines established by the State Mining and Geology Board have been adapted to the California Mineral Land Classification Diagram (Figure 3). These adaptations are presented below:

MRZ-1: Areas where available geologic information indicates there is little likelihood for the presence of mineral resources.

MRZ-2a: Areas that contain significant measured or indicated reserves.

MRZ-2b: Areas where geologic information indicates that significant inferred resources or demonstrated sub-economic resources are present.

MRZ-3a: Areas likely to contain undiscovered mineral deposits similar to known deposits in the same producing district or region (hypothetical resources).

MRZ-3b: Areas judged to be favorable geologic environments for mineral resource occurrence, but where mineral discoveries have not been made in the region (speculative resources).

MRZ-4: Areas where geologic information does not rule out either the presence or absence of mineral resources.

Mineral land classification addresses specific types of mineral deposits which occur, or are likely to occur, in the project area. The type of mineral deposit for which a particular area is classified is denoted by a superscript letter following the assigned MRZ category (e.g. MRZ-$2b^{(h)}$) for deposits formed by hydrothermal processes). Also, superscript reference numbers are used to identify specific MRZ areas discussed in the report (e.g. MRZ-$2b^{(h-2)}$).

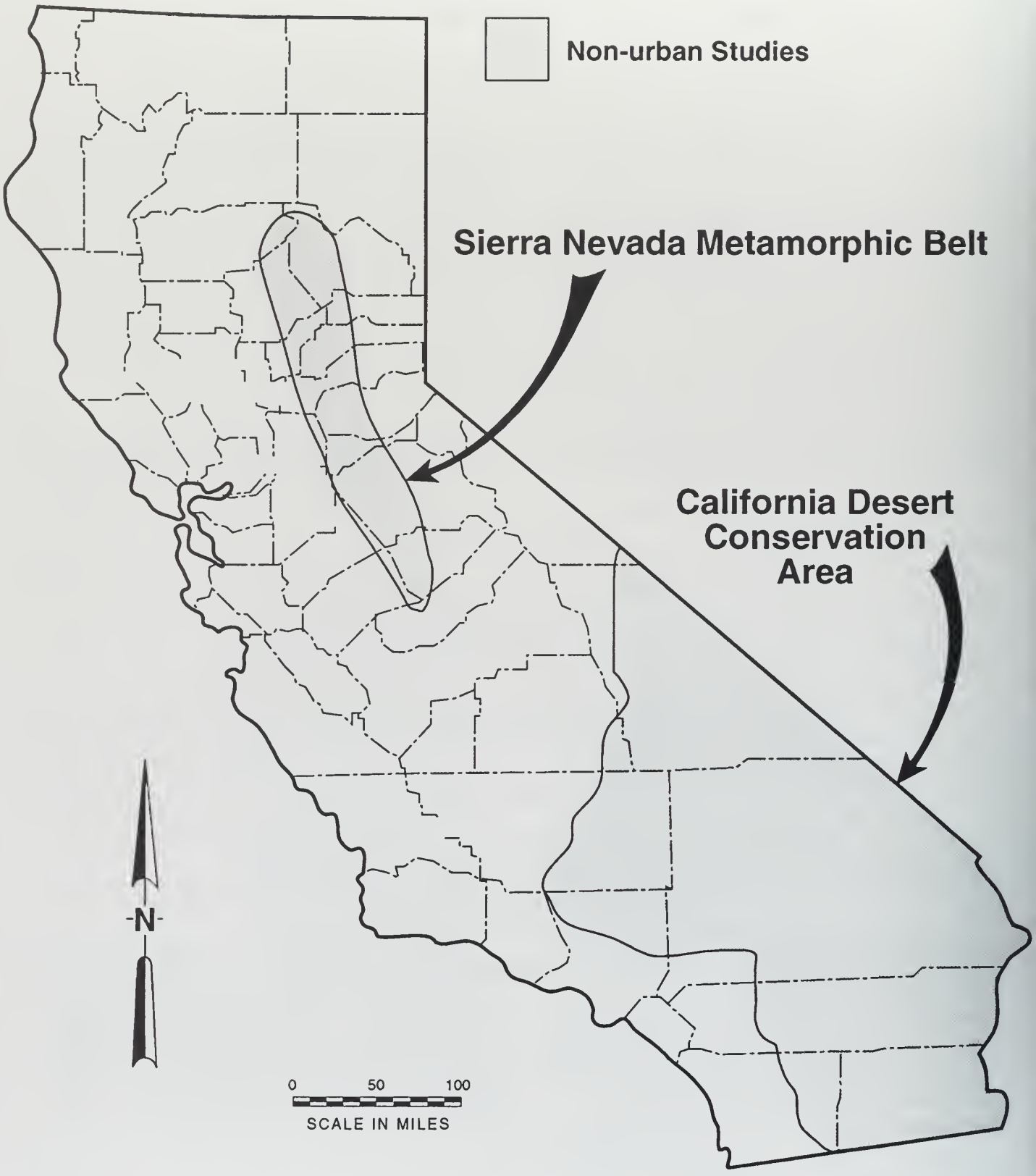

Figure 1. Map of California showing nonurban regions of the State subject to mineral land classification

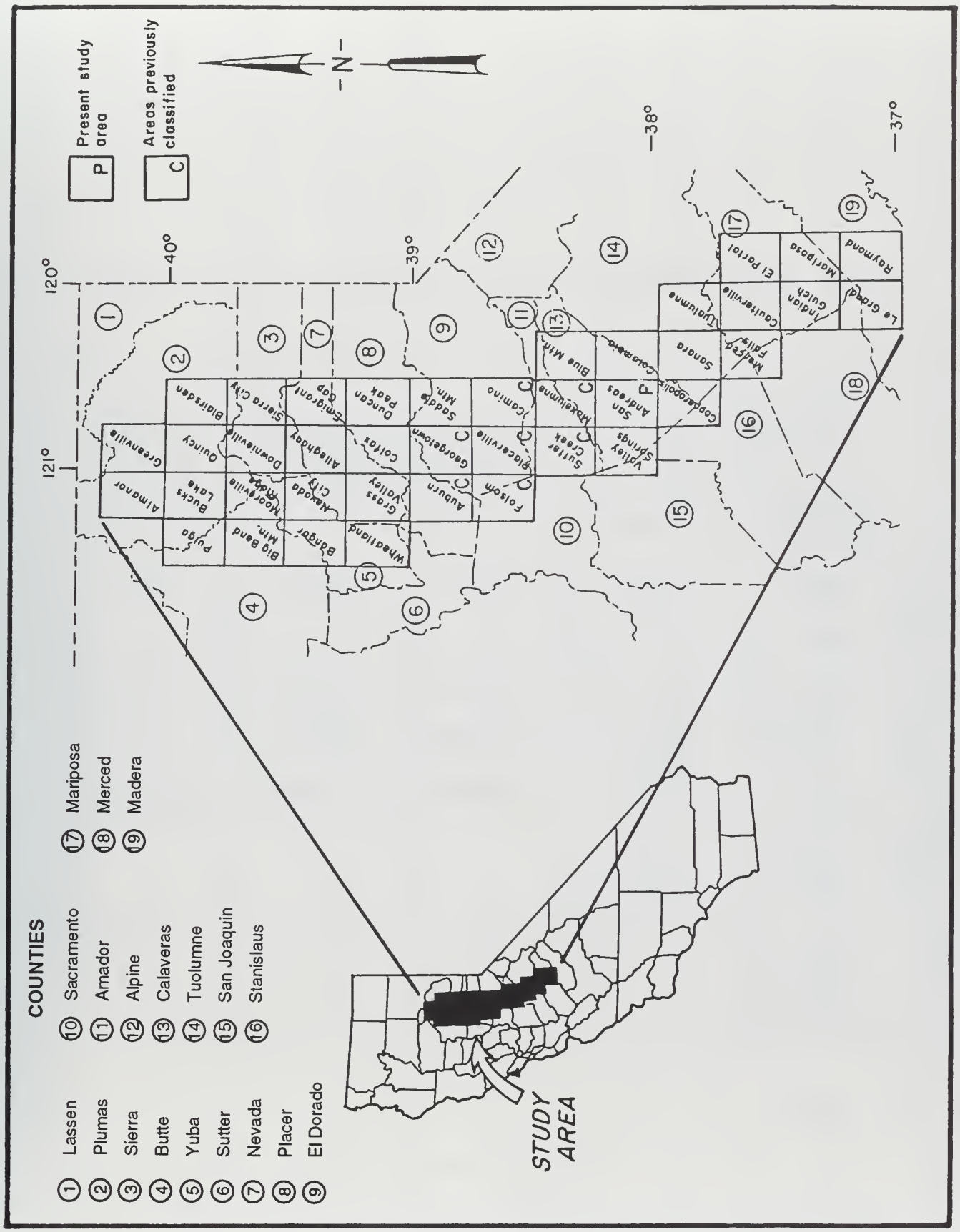

Figure 2. Index map of 15-minute quadrangles of the Sierra Nevada foothill project area.

SUMMARY OF MINERAL RESOURCE ZONE ASSIGNMENTS

Assignment of mineral resource zones are based on a geologic and mineral resource survey which was conducted during the course of this study (see Parts II and III). As discussed in Part III, the survey indicates that five types of mineral deposits are present, or are likely to be present, in the study area. These are: (1) deposits formed by hydrothermal processes which contain gold and associated metals (denoted by the superscript letter "h"); (2) industrial minerals, which include limestone, dolomite, marble, and talc (denoted by the superscript letter "i"); (3) deposits formed by magmatic concentration which contain chromite (denoted by the superscript letter "m"); (4) deposits formed by volcanogenic processes which contain copper, zinc, gold, and associated metals (denoted by the superscript "v"; and (5) placer gold deposits (denoted by the superscript letter "p").

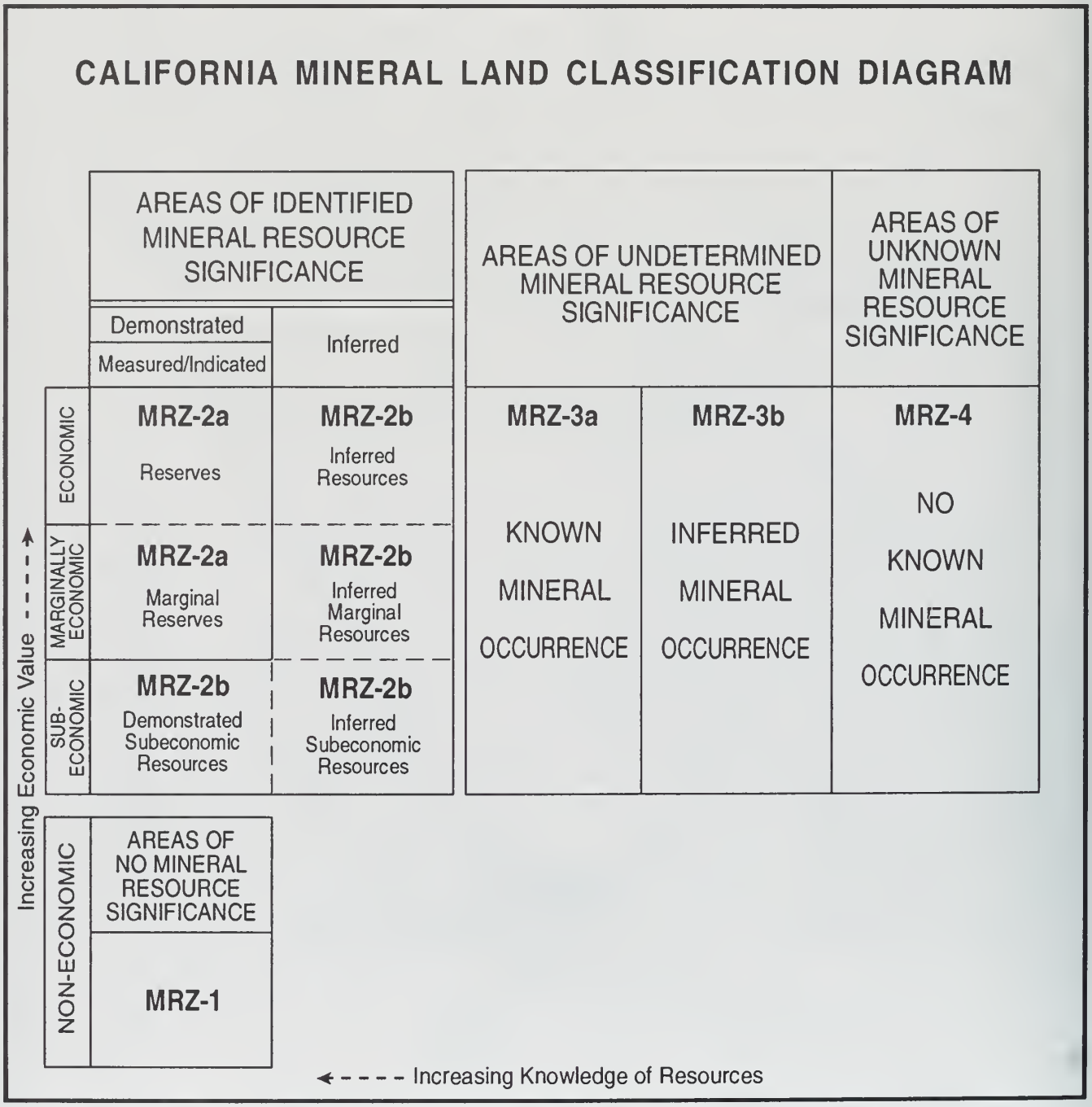

Figure 3. California Mineral Land Classification diagram: Diagrammatic relationship of mineral resource zone categories to the Resource/Reserve Classification System. See Appendix B for explanation of nomenclature.

Table 1. Summary Listing of Areas Classified MRZ-2 and MRZ-3 for Deposits Formed by Hydrothermal Processes (see Plate 2)

Resource Zone	Name/Vicinity	Reserves/Resources	Supporting Evidence for MRZ Assignment**
MRZ-2a$^{(h-1)}$	Mountain King - Royal Mine Area	Indicated lode gold reserves	Ore reserves based on drilling program report 9.07 million tons averaging 0.070 ounces of gold per ton and 1.44 million tons averaging 0.025 ounces of gold per ton.
MRZ-2a$^{(h-2)}$	Carson Hill Mine Area	Indicated lode gold reserves	Ore reserves reported are about 16 million tons grading 0.046 ounces of gold per ton.
MRZ-2b$^{(h-1)}$	Mother Lode Gold Belt	Inferred lode gold resources	Field evidence and historic mining activity provide ample evidence for the overall continuity of a major mineralization system in which ore grade material is not likely to have been depleted. Highly probable exploration drilling will upgrade some properties to the MRZ-2a category.
MRZ-2b$^{(h-2)}$	Big Seven Mine Area	Inferred lode gold resources	Historic mining activity, a zone containing an extensive degree of kaolinization, silicifiation and disseminated pyrite, coupled with assays of 0.014 to 0.062 ounces of gold per ton suggest that significant lode gold resources exist.
MRZ-3a$^{(h-1)}$	Gourley Reservoir Area	Moderate to high potential for lode gold resources	Situated between two apparent branches of the Mother Lode gold belt its location suggests a moderate to high potential for the presence of undiscovered gold resources.
MRZ-3a$^{(h-2)}$	Area west of Mother Lode Belt	Moderate to high potential for lode gold resources	Historic gold mines and prospects along the zone indicate that gold mineralization occurs sporadically and discontinuously.
MRZ-3a$^{(h-3)}$ (Plate 2b)	Area east of Mother Lode Belt	Moderate to high potential for lode gold resources	Historic gold mines and prospects along quartz veins which carry varying amounts of gold. Mineralization occurs sporadically and discontinuously along belt, and most likely is controlled by isolated, localized structures.
MRZ-3a$^{(h-4)}$	Area east of Gold Belt	Moderate to high potential for lode gold resources	Historic gold mines and prospects along quartz veins which carry varying amounts of gold. Mineralization occupies fault and fracture openings which generally follow the foliation of the rocks within the Calaveras Complex.
MRZ-3a$^{(h-5)}$	Big Seven Ridge Area	Moderate potential for additional lode gold resources	Area is judged to have potential for additional gold resources associated with the Big Seven Mine deposit.
MRZ-3a$^{(h-6)}$	Hodson Mining District	Moderate to high potential for lode gold resources	Area envelopes the Hodson Mining District which contains the Royal Mountain-King Mine (MRZ-2a).

Table 2. Summary Listing of Areas Classified MRZ-2 and MRA-3 for Deposits Formed by Volcanogenic Processes. (see Plate 3)

Resource Zone	Name/Vicinity	Reserves/Resources	Supporting Evidence for MRZ Assignment**
MRZ-3a$^{(v-1)}$	Foothill Copper-Zinc Belt	Moderate potential for massive sulfide deposits	Area underlain by metavolcanic rocks of the Late Jurassic Copper Hill Volcanics. Two known massive sulfide deposits are located within this belt.
MRZ-3b$^{(v-1)}$	Hogback Mountain Area	Low potential for massive sulfide deposits	Area underlain by the Logtown Ridge Formation which is considered to be a favorable host rock for massive sulfide deposits.

Table 3. Summary Listings of Areas Classified MRZ-2 and MRZ-3 Industrial Minerals. (see Plate 4)

Resource Zone	Name/Vicinity	Reserves/Resources	Supporting Evidence for MRZ Assignment**
MRZ-2a$^{(i-1)}$	Red Hill Talc Quarry	Measured reserves of talc	Quarry is the site of an active mine operated by Western Source, Inc. Demonstrated quality of the talc and the substantial amount of rock remaining at the quarry justify the MRZ-2a.
MRZ-2b$^{(i-1)}$	Kentucky House Limestone Deposits	Inferred resources of cement grade limestone	Property was operated in continuous production from 1922 to 1980. Deposit occurs as two lenses that are 400 to 500 feet wide and up to 2000 feet in length.
MRZ-2b$^{(i-2)}$	Calaveritas Limestone Deposits	Inferred resources of high-calcium limestone	Deposit contains large bodies of high-calcium and dolomitic limestone. Limestone occurs as complexly folded and faulted masses, some measuring in excess of 1,200 feet in length and 800 feet in width.
MRZ-2b$^{(i-3)}$	Cave City Carbonate Rock Deposits	Inferred resources of high-calcium limestone	Deposit forms an elongate body of carbonate rock ranging from 600 to 1,500 feet in thickness and extends for almost 4 miles along strike.
MRZ-3a$^{(i-1)}$	Bear Mountains Serpentinite Belt	Moderate potential for resources of asbestos and talc	Ultramafic rocks are exposed along the Bear Mountain fault zone. Several deposits have been sporadically mined in the past and currently talc and asbestos are produced from similar ultramafic rocks along the foothill region.
MRZ-3a$^{(i-2)}$	Melones Fault Zone	Moderate potential for resources of talc, asbestos and carbonate rock	Lenticular masses of both carbonate rock and ultramafic rock occur within the Melones fault zone. Small amounts of talc and serpentine containing asbestos have been reported, and small high-grade limestone masses exist.
MRZ-3a$^{(i-3)}$	Calaveras Complex	Moderate potential for resources of talc	Calaveras Complex contains numerous shear zones in which masses of talc-bearing schist occur. Schist contains talc-bearing serpentine which is similar to the Red Hill Talc Mine which is presently producing industrial grade talc.
MRZ-3a$^{(i-4)}$	Silica Zone	Moderate potential for industrial grade quartz	A series of thick quartz veins, some of which have produced industrial grade quartz in the past, occur within this zone.
MRZ-3a$^{(i-5)}$	Carbonate Rock within the Calaveras Complex	Moderate potential for carbonate rock resources	Small deposits of carbonate rock occur within the Calaveras Complex. Most of the deposits are dolomitic or interbedded limestone and dolomite of small areal extent.

Table 4. Summary Listings of Areas Classified MRZ-2 and MRZ-3 Industrial Minerals. (see Plate 5)

Resource Zone	Name/Vicinity	Reserves/Resources	Supporting Evidence for MRZ Assignment**
MRZ-3a$^{(a-1)}$	Bear Mountains Serpentinite Belt	Moderate potential for resources of chromite	Chromite deposits occur in ultramafic rock marking the trace of the Bear Mountain fault zone; fifteen of these deposits have been mined or prospected in past years. Most of the deposits have been worked out; however, little if any exploration drilling to discover new or related deposits has been carried out since the 1940s.
MRZ-3b$^{(a-1)}$	Melones Fault Zone	Low potential for resources of chromite	The association of chromite deposits to the Bear Mountain fault zone and the occurrence of small deposits of chromite elsewhere along the Melones fault zone associated with serpentinite masses similar to ones contained within the Melones.
MRZ-3b$^{(a-2)}$	Calaveras Complex	Low potential for undiscovered resources of chromite	Small, disjointed lenticular masses of serpentine occur within the Calaveras Complex. However, only one location, the Madrid mine, has produced any chromite. Due to the overall lack of serpentine within the Complex, and the lack of evidence for chromite mineralization the area has been classified MRZ-3b.

Table 5. Summary Listing of Areas Classified MRZ-2 and MRZ-3 Placer Gold Deposits. (see Plate 6)

Resource Zone	Name/Vicinity	Reserves/Resources	Supporting Evidence for MRZ Assignment**
MRZ-3a$^{(p-1)}$	Auriferous Gravels of the Ancient Calaveras River	Moderate potential for undiscovered placer gold deposits	Historically placer gold has been mined within the area from Eocene stream gravels, as well as gravels occurring in the Valley Springs and Mehrten Formations, from Recent stream deposits, and locally from alluvial deposits.
MRZ-3a$^{(p-2)}$	Modern River and Stream Beds	Moderate potential for placer gold resources	Placer gold continues to be mined on a small scale from river and stream beds within the area. Thus, all major rivers and streams which drain areas containing lode gold deposits or auriferous Tertiary channel deposits have been classified MRZ-3a for placer gold resources

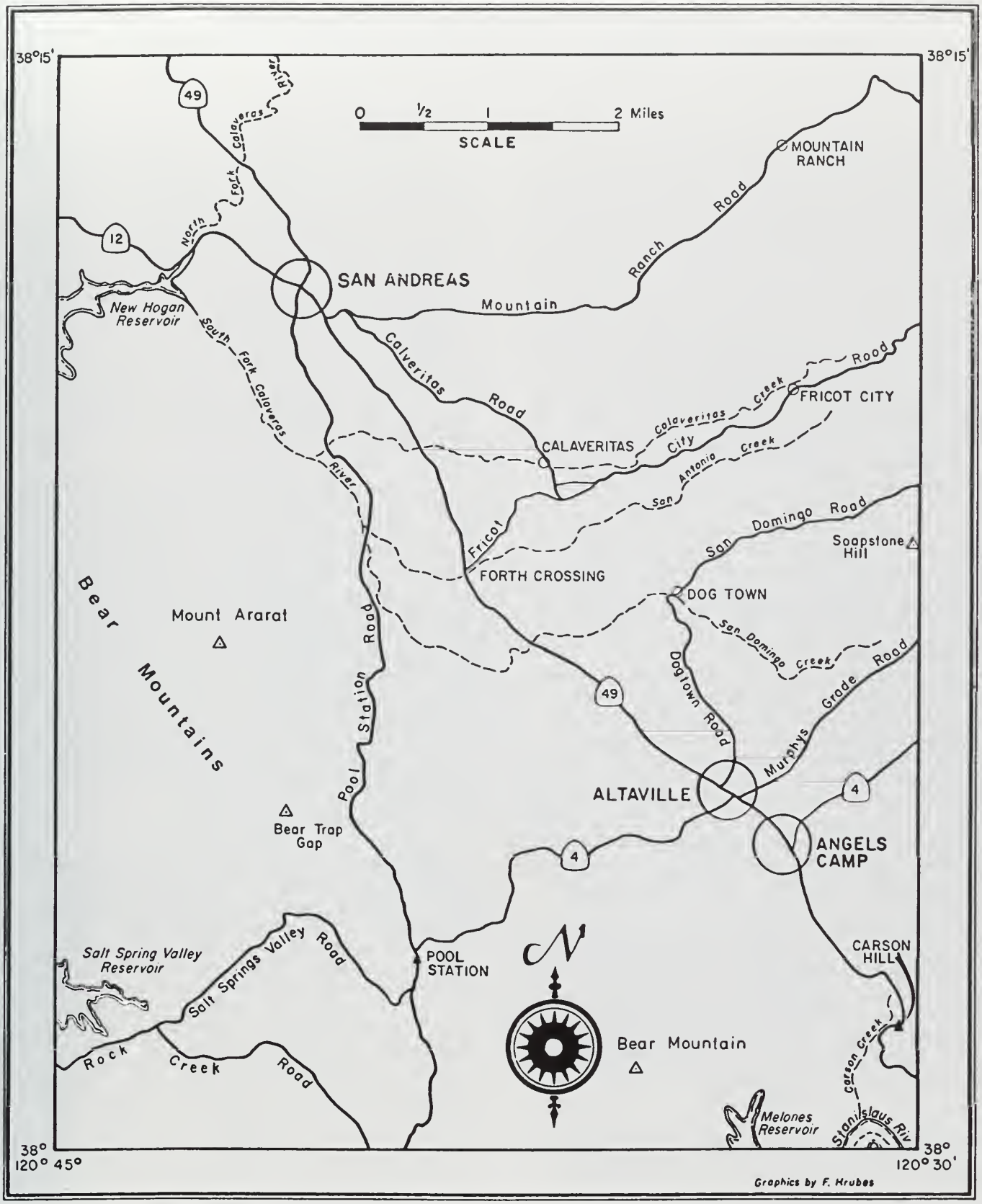

Figure 4. Map of San Andreas 15-minute quadrangle showing roads, major drainages, and population centers. Scale approximately 1:125,000.

PART II - GEOLOGY AND MINERAL RESOURCES SUPPORTING INFORMATION FOR MINERAL RESOURCE ASSESSMENT

GEOGRAPHIC SETTING

The San Andreas quadrangle encompasses about 240 square miles of land situated along the western foothill region of the Sierra Nevada of California (Figure 4). Although most of the area lies within Calaveras County, a small portion located in the southeast quarter of the quadrangle is situated within Tuolumne County. Elevations range from approximately 680 feet in the western part of the study area to over 2,800 feet in the northeastern part. Most of the topography is characterized by north and northwest-trending ridges and troughs, with local relief being low to moderately high while the northeastern portion of the area is dominated by eastwest to northeast trending ridges and steep valleys. The Calaveras and Stanislaus Rivers are the major drainages in the area. Their principle tributaries include Calaveritas, San Antonio, Marray, San Domingo, Six Mile, Indian, Carson and Angels Creeks. Depending on factors such as elevation, slope exposure, and soil cover, vegetation communities in the study area consist of open grassland, chamise, chaparral, oak woodland and mixed coniferous forest land, principally digger pine. The climate is hot during the summer and mild in the winter. Snowfall in the Sierra Nevada normally occurs at higher elevations than that of the study area. Annual rainfall in the study area is about 28 inches.

State Highway 49 traverses the central portion of the quadrangle in a northwesterly direction via Carson Hill, Angels Camp, Altaville, and San Andreas. State Highway 12 extends eastward from Lodi, passing through Valley Springs and terminating at San Andreas while State Highway 4 extends east and northeastwardly from Stockton through Copperopolis, Angels Camp and across the Sierran crest. A number of county roads such as Mountain Ranch, Fricot City, Pool Station, Murphy's Grade and Salt Springs Valley Roads, as well as several paved and unpaved county roads, provide reasonable access into most of the study area.

The main population centers are concentrated along U.S. Highway 49, where the communities of Angels Camp, Altaville, and San Andreas are situated and in several isolated foothill home developments. Most of the area is utilized by ranchers for cattle and sheep grazing. However, considering present growth patterns in the Sierra Nevada foothill belt, this sparsely inhabited area is subject to widespread urban encroachment in the near future.

GEOLOGY

It has long been recognized that the nature and distribution of mineral deposits relate to the geology of a region. Consequently, a general understanding of the lithologic and structural framework of a region is of considerable value for evaluating mineral potential. The following discussion is provided to familiarize the reader with aspects of the geology that controlled or influenced the formation of mineral deposits in the San Andreas quadrangle.

Regional Geologic Framework

The San Andreas quadrangle occupies land along a northwest- trending belt of metamorphic rocks which underlies the western slope of the Sierra Nevada between Mariposa and Lake Almanor (Figure 5). These rocks are distributed within three major fault-bounded lithologic terranes that extend along the length of the metamorphic belt. Each of the terranes is composed of thick accumulations of Paleozoic and Mesozoic marine sedimentary and volcanic rocks that have been deformed, intruded, and metamorphosed. The rocks have been isoclinally folded on a regional scale and faulted to such an extent that stratigraphic thicknesses rarely can be accurately measured. Bedding, foliation, and major structural features throughout the metamorphic belt generally trend north to northwest and dip steeply eastward.

Detailed geologic mapping (scale 1:24,000) is lacking over most of the 9,000 square-mile area of the Sierra Nevada metamorphic belt. Presently, geologists interpret the overall lithologic and structural framework of the belt in terms of plate tectonic concepts. There is general agreement that convergent plate tectonism governed the Early Paleozoic to Late Jurassic development of the belt and that the fault-bounded terranes collectively represent a "collage" of tectonically accreted terranes emplaced along the western margin of the North American continent at various intervals during geologic time. The narrative that follows summarizes the geologic framework of the area. For a more detailed understanding, the reader is referred to recent publications by Howell and McDougal (1978, Ernst (1961) and Saleeby (1982).

Eastern Terrane

The eastern terrane is bounded on the east by intrusive contacts of granitoid rocks of the Sierra Nevada batholith and on the west by faults of the Calaveras-Shoo Fly thrust and northern Melones fault system (Figures 5 and 6). Most of the terrane is composed of metasedimentary rocks of the Shoo Fly Complex (Early Paleozoic). The Shoo Fly Complex was named as a formation by Diller (1892) for stratified continental rise and slope deposits composed principally of quartz sandstone and argillite that are exposed northeast of Quincy. Subsequently, McMath (1966), Clark (1976), d'Allura and others (1977), and Schweikert (1981) mapped the Shoo Fly Complex at least as far south as the Merced River, incorporating miogeoclinal rocks into the Shoo Fly that were previously assigned to the Calaveras Complex. In the northeastern part of the eastern terrane, the Shoo Fly Complex is unconformably overlain by Late Devonian to Upper Jurassic marine sedimentary and volcanic rocks (Figure 5). These are summarized by d'Allura and others (1977) , Harwood (1983) , and Hanna and Moores (1986) .

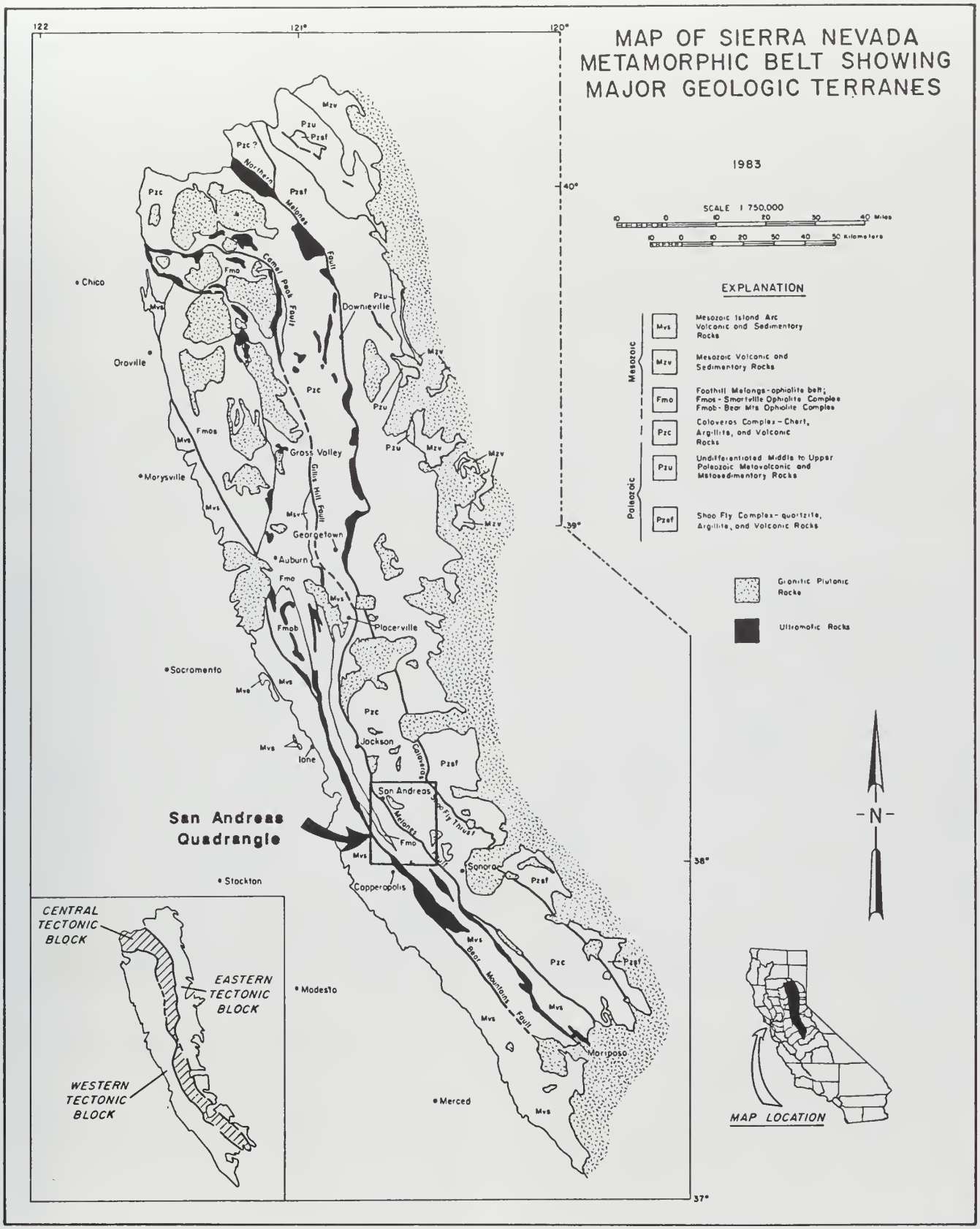

Figure 5. Geologic Map of Sierra Nevada metamorphic belt. Compiled from Jennings (1977), Kemp (1982), Hietanen (1981), and Harwood (1983).

Central Terrane

The central terrane is bounded on the east by the Calaveras-Shoo Fly thrust and northern Melones fault system, and on the west by the southern Melones and, perhaps, the extension of the Gillis Hill-Camel Peak fault system as mapped by Hietanen (1981) and Chandra (1961, Figure 5). Metamorphic rocks forming the central terrane are assigned to the Calaveras Complex, which is composed mainly of semi-coherent to chaotic beds of chert and argillite, along with minor volcanic and carbonate rocks. These deposits are thought to have accumulated in deep ocean and marginal basin environments beginning in Middle Paleozoic time (Schweikert and Snyder, 1981; Miller, 1982) and later accreted to the continent during the Sonoma orogeny in Permo-Triassic (?) time (Schweikert and Snyder, 1981).

The term Calaveras Formation was first introduced by Turner (1893a, 1893b) for all Paleozoic metasedimentary and metavolcanic rocks exposed in the Sierra Nevada, except for Lower to Middle Paleozoic rocks mapped north of Quincy by Diller (1892). Subsequent workers have substituted the term complex for Formation and have reassigned more than half of the original sequence to the Shoo Fly Complex.

Western Terrane

The western terrane is bounded on the east by the southern Melones fault and in the northern foothill region by the postulated Gillis Hill-Camel Peak fault extension. Its western boundary is concealed by unconformably overlapping Cenozoic volcanic and sedimentary deposits (Figure 5). The terrane is characterized by several distinctive metamorphic lithologies of which the most extensive and continuous is Upper Jurassic volcanic and sedimentary rocks of island arc derivation. These are exposed in two subparallel belts extending between the Fresno River and Oroville (Figure 5). In the southern foothills area, the two belts are divided by the Bear Mountains fault zone and in the central and northern regions by melange-ophiolite basement rock. Volcanic rocks in both belts are dominated by thick piles of basaltic and andesitic pyroclastic deposits in which pillow lava and volcaniclastics are common. Alternating with the volcanics are several thick and relatively-continuous epiclastic rocks composed mostly of black-grey slate and associated graywacke, conglomerate, and tufaceous beds.

As summarized by Clark (1964, 1976), both belts have been divided into several formations on the basis of alternating volcanic and sedimentary sequences. The eastern belt contains Peñon Blanco Volcanics (Late Triassic? - Early Jurassic?), volcanic rocks of the Logtown Ridge Formation (Late Jurassic), and slate, graywacke, conglomerate, and volcanic rocks of the Mariposa Formation (Late Jurassic). The western belt is composed of the Peaslee Creek Volcanics, Merced Falls Slate, Gopher Ridge Volcanics, Salt Springs Slate, Copper Hill Volcanics, and Smartville Complex, all of which are considered to be of Late Jurassic age.

Although stratigraphic and structural relationships are unclear, it is believed that the Upper Jurassic island arc deposits were developed over older melange-ophiolite basement rocks which crop out within the western block (Figure 6). The use of the term melange to describe this complex and often chaotic assemblage of rocks of various lithologies and ages within the Sierra Nevada foothills, was applied by Duffield and Sharp (1975). Their work and subsequent mapping by Morgan (1976), Parkison (1976), Behrman (1977, 1978), Behrman and Parkison (1978), and Schweikert (1978), Saleeby and others (1978), Xenophontos and Bond (1978), Saleeby (1981, 1982), Tuminas (1984) and Xenophontos (1984) show that a belt of chaotic and highly disrupted sedimentary, volcanic, and ophiolitic (oceanic crust and upper mantle) rocks form a continuous span in the Sierra Nevada foothills extending between the Tuolumne River and the North Fork Feather River (Figure 5).

Structure

The Sierra Nevada metamorphic belt is dominated by a series of north to northwest-trending fault systems extending through the length of the foothill region (Figure 5). The systems are commonly marked by long, narrow bands of serpentinite, talc-chlorite schist, quartz veins, mariposite, and highly-sheared and foliated country rock. Major fault systems of the Sierra Nevada foothill region include the Calaveras-Shoo Fly thrust (Schweikert, 1981; Schweikert and Bogen, 1983), the Melones fault, and the Bear Mountains fault (Clark, 1964, 1976; Duffield and Sharp, 1975; Behrman, 1977, 1978; Wagner and others, 1981; see Figure 5). South of Placerville, the faults are generally mapped as continuous, linear features with relatively few structural complexities. From the Placerville area north, however, the Bear Mountains and Melones faults branch out as a network of structurally complex and poorly-defined fault systems. Structural interpretation of rock units, herein assigned to the eastern, central, and western tectonic blocks north of Placerville, suggest the northern and southern extents of the Melones fault zone are parts of two separate systems. The northern extent of the Melones fault zone appears to represent a continuation of the Calaveras-Shoo Fly thrust (Schweikert, 1981, p. 90). The southern extent of the Melones fault, which appears to continue northwest from Placerville through the Greenwood area along an unnamed and poorly mapped fault, may be continuous with the Gillis Hill fault of Chandra (1961) and the Camel Peak fault of Hietanen (1981, Figure 5).

GEOLOGY OF THE SAN ANDREAS QUADRANGLE AREAS

The first published geologic map encompassing the San Andreas 15-minute quadrangle was one made by Turner (1894). Various portions of the quadrangle were subsequently mapped in more detail by Clark (1954), Eric, Stromquist, and Swinney (1955), Clark and Lydon (1962), Clark (1964) and L.D. Clark (1970). A compilation of their mapping, along with modifications resulting from this study, is displayed on Plate 1.

As shown on Figure 5, the study area includes the central and western portions of the Sierra Nevada metamorphic belt, and encompasses both bedrock and over-

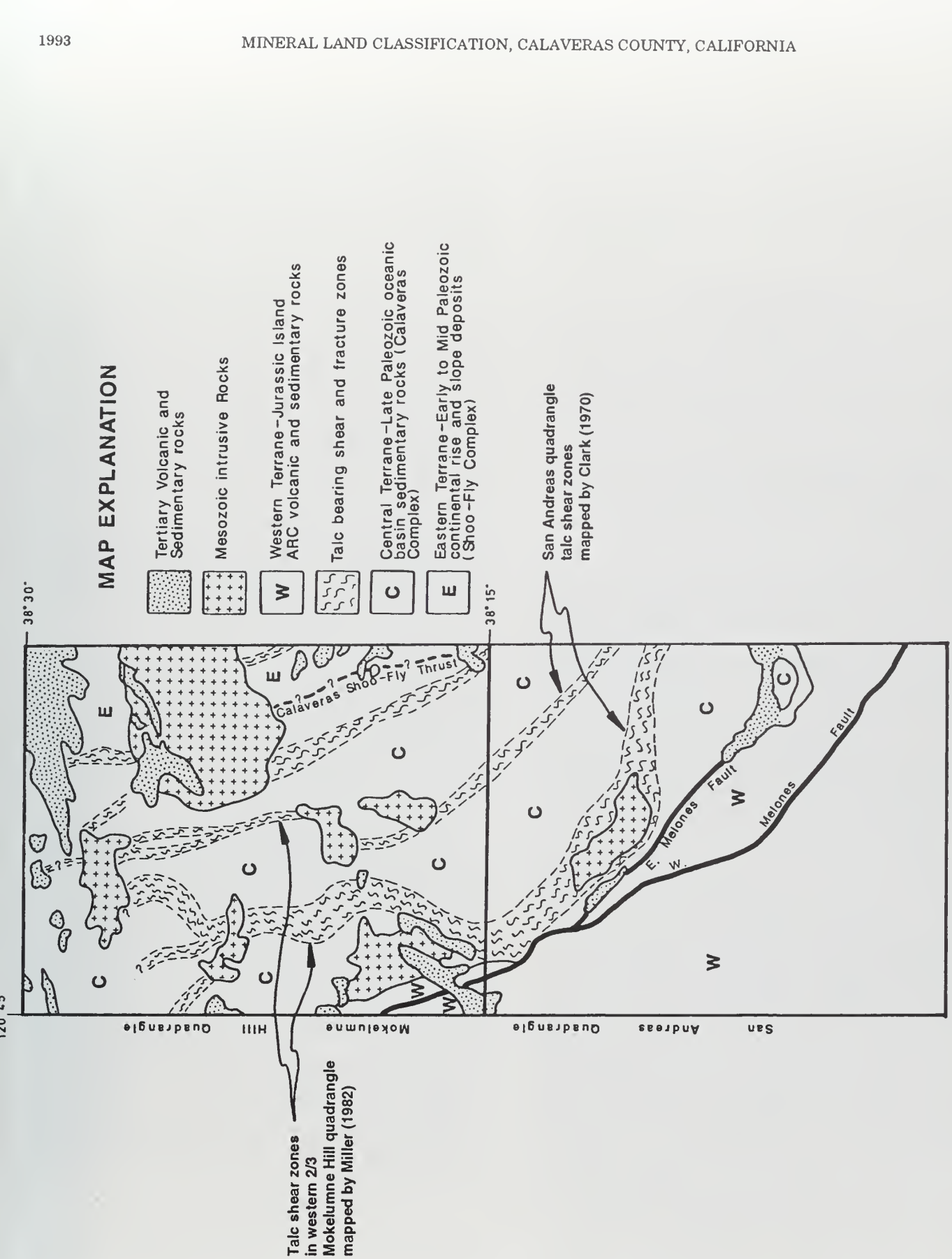
MAP EXPLANATION
Tertiary Volcanic and Sedimentary rocks
Mesozoic intrusive Rocks
Western Terrane–Jurassic Island ARC volcanic and sedimentary rocks
Talc bearing shear and fracture zones
Central Terrane–Late Paleozoic oceanic basin sedimentary rocks (Calaveras Complex)
Eastern Terrane–Early to Mid Paleozoic continental rise and slope deposits (Shoo–Fly Complex)
San Andreas quadrangle talc shear zones mapped by Clark (1970)
Talc shear zones in western 2/3 Mokelumne Hill quadrangle mapped by Miller (1982)
38°30'
38°15'
Calaveras Shoo–Fly Thrust
E. Melones Fault
W. Melones Fault
Mokelumne Hill Quadrangle
San Andreas Quadrangle

Figure 6. Map showing talc-bearing shear zones in and adjacent to the project area. Adapted from Miller (1982).

lapping sedimentary deposits of Tertiary age. Exposed bedrock consist of the Late Jurassic island arc Copper Hill Volcanics, Salt Springs Slate, Gopher Ridge Volcanics, the Logtown Ridge and Mariposa Formations, older mafic volcanic and associated rocks of the Bear Mountain ophiolite, and the Paleozoic Calaveras Complex (Plate 1).

Lithology

Western Terrane

About 40 percent of the rocks exposed in the San Andreas quadrangle are included in the western tectonic block. It includes rocks of the Upper Jurassic volcanic island arc terrain, which are exposed in two belts separated by rocks of the melange-ophiolite complex (Figure 5, Plate 1)

The western island arc belt is made up of rocks of the Copper Hill Volcanics, Salt Springs Slate, and Gopher Ridge Volcanics. The eastern island arc belt contains rocks of the Logtown Ridge and Mariposa Formations.

The Gopher Ridge Volcanics crop out in a small area in the southwestern corner of the quadrangle and are composed mostly of basaltic and andesitic pyroclastics, lava, and pillow lava together with felsic porphyritic and pyroclastics rocks that generally trend N25°W and dip about 60° to the northeast. The Gopher Ridge Volcanics are more silicic than other Jurassic volcanic rocks of the region (Clark, 1964).

The Salt Spring Slate is made up mostly of dark grey slate with subordinate tuff, graywacke, and conglomerate that generally trends N25°W and dips about 80° to the northeast. The slate intertongues with overlying Copper Hill Volcanics in the southwestern part of the quadrangle (Clark, 1970).

The Copper Hill Volcanics, which are exposed in the southwestern part of the quadrangle, include mafic to andesitic pyroclastic rocks, lava and pillow lava together with a thick flow of amygdaloidal basalt. These rocks generally trend N25°W and dip 75° to the northeast. The Copper Hill Volcanics are traversed by at least two shears which follow a northwest trend and contain large blocks of ultramafic rock. It is along these shears that most of the copper prospects occur within the study area.

The northwest trending melange-ophiolite basement complex exposed within the San Andreas quadrangle consists of a chaotic rock assemblage dominated by tuff, slate, quartzite, conglomerate, graywacke, and carbonate rock (L.D. Clark, 1970). Chromite occurs in ultramafic rocks within and bordering the melange.

The Logtown Ridge and Mariposa Formations form an interbedded series of pyroclastic and sedimentary rocks that trend N40°W and dip 70° northwest and extends across the center of the study area. The Logtown Ridge Formation is composed of coarse mafic volcanic breccia, in part porphyritic, with subordinate tuff, lapilli tuff and minor pillow lava. The Mariposa Formation contains dark gray slate with tuff, tuffaceous sandstone, graywacke, siltstone, and conglomerate.

The Paleozoic- Mesozoic (?) (Pz Mz) rocks within the Melones fault zone are represented by highly sheared and recrystallized metamorphic rocks composed of phyllitic greenstone, slate, amphibolite, graywacke, conglomerate, and carbonate rock. The rocks follow a trend ranging from N5°W to N50° through the area in a discontinuous pattern and locally contains large carbonate bodies.

The late Jurassic rocks bounded by the Melones and Sonora faults are made up of green schist (Jv) and phyllite (Js). The green schist (Jv) is derived from volcanic augitic and plagioclase-bearing tuff breccia, massive flows, flow breccia, gabbro and andesite with some phyllite. The phyllite and metagraywacke unit (Js) is composed of phyllite, volcaniclastic graywacke, and volcanic-pebble conglomerate and is more abundant than the green schist. The rocks can be traced from the southwest corner of the study area to a point 0.5 miles northwest of San Andreas where the Melones and Sonora faults merge.

Within these rocks, bedding and schistosity normally trends northwest and dips steeply eastward. Although exposures are generally poor, cleavage and bedding features observed at some outcrops indicate large scale isoclinal folds are common structural features.

Central Terrane

About 40 percent of the rocks exposed in the area belong to the Calaveras Complex which forms the central block. The Complex occupies the northeast portion of the quadrangle and is made up of interbedded chert, graphitic phyllite, blocks of recrystallized carbonate rock, and green schist derived from pyroclastic volcanic rocks. Some of the larger blocks of carbonate rock have been used in the past for making cement.

The trend of the foliation ranges from N10°W in the northern portion of the quadrangle to eastwest in the area centered about Calaveritas and Fricot City. Foliation in the southern part of the study area follows a trend of N30°W. The eastwest trend of the central portion of the Calaveras Formation is transverse to the main northwest trend of the Mother Lode and in a general way coincides with a change in the character of mineralization in the main Mother Lode belt. Within this section of the Mother Lode, mineralization occurs as parallel to subparallel quartz veins with intervening ground that has been well silicified and in some places displays prominent pyritization which contrasts with the mineralization of the Mother Lode area in the northern part of the quadrangle where mineralization is mostly confined to lode gold deposits enclosed by quartz veins that typically do not display extensive hydrothermal affects upon the country rock.

Intrusive Rocks

A relatively prominent grandiorite pluton crops out about a mile east of the town of San Andreas. The pluton, which has been described by Clark (1954), intrudes rocks of the Calaveras Complex near the Sonora fault. Two smaller dioritic plutons occur in the study area, one intruding Mariposa Formation about 3 miles southwest

of San Andreas and the other intruding Copper Hill Volcanics near the southern boundary of the quadrangle. Both of these have been described by L.D. Clark (1970). All plutonic rock within the quadrangle show variation in texture and composition, particularly near their margins, where they locally display a mafic composition. Generally, intrusive rocks of the west-central Sierra Nevada foothills have been assigned a Late Jurassic age by previous workers, as summarized in Stern and others (1981).

Cenozoic Deposits

Remnants of ancient river channel deposits, preserved through time by cappings of younger resistant volcanic rock, crop out along some of the ridge tops in the northeast, northwest, and southeast portions of the study area. They represent erosional remnants of major river systems that once drained the Eocene Sierra Nevada landscape. These Tertiary channel deposits have been worked extensively in the past for their gold content.

Ridge-capping exposures of Mehrten and Valley Springs rocks crop out along the apparent courses of northwest trending Tertiary streams that flowed through the central part of the quadrangle. A few exposures of these rocks occur in the northeast corner of the quadrangle where they overlie ancient river channel deposits. Their exposures in the southeast corner of the quadrangle overlie parts of the extensively mined ancient stream channel deposit of the Vallecito and Calaveras Central Districts. The Tertiary deposits, which overlie metamorphic rock with marked angular unconformity throughout the northern and central Sierra Nevada, are described by Lindgren (1911); Piper and Gale and others (1939); and Bateman and Wahraftig (1966).

Structure

The Melones and Bear Mountain fault systems represent major structural features of the Sierra Nevada and extend through the area shown in the San Andreas quadrangle (Plate 1). The Melones and Sonora fault zones can be traced from Carson Hill to San Andreas and northward, and is composed of a band (750-15,000 feet wide) of highly sheared, recrystallized metamorphic rock. Located between the Melones and Sonora faults and oriented generally parallel to them, is the gold-bearing quartz vein system of the Mother Lode belt. These veins occupy east dipping faults referred to by Clark (1964) as the "Mother Lode Fissure System".

The Bear Mountain fault zone, a prominent structural feature in the study area, juxtaposes rocks of the Bear Mountain ophiolite on the east with the Late Jurassic island arc rocks on the west, and is marked by highly sheared amphibolite schist and elongate pods of serpentinized ultramafic rock (Plate 1). A number of chromite prospects, some of which have yielded production in the past, are located along the fault zone.

As mentioned previously, certain types of mineral deposits may be associated with certain geologic environments, rock types, and structures. In the San Andreas quadrangle, these associations include (1) polymetallic sulfide deposits associated with the Copper Hill, Gopher Ridge, and Bear Mountain ophiolite volcanic terrane (2) hydrothermal gold deposits occurring within fault and fracture-filling quartz veins and associated altered country rock (3) chromite and talc associated with ultramafic rock (4) placer gold deposits in Cenozoic sedimentary deposits, and (5) carbonate rock within the Calaveras Formation and the terrane east of the Melones fault. These are described in the Mineral Land Classification section of this report.

GEOPHYSICAL EVALUATION OF THE SAN ANDREAS QUADRANGLE

by G.W. Chase, R.H. Chapman, and L.G. Campbell

Aeromagnetic Data

Airborne and ground magnetic surveys are commonly used to help evaluate areas for possible mineral resources. These magnetic surveys are effective for locating ore deposits that contain the minerals magnetite or pyrrhotite. They also can be used to explore for non-magnetic ore deposits that are associated either with host rocks containing magnetic minerals, or with geologic structures that can be delineated by magnetic means.

Figure 7 is an aeromagnetic map of the San Andreas quadrangle (Henderson and others, 1966; U.S. Geological Survey, 1969). The aeromagnetic map shows a predominant pattern of linear northwest-trending anomalies having amplitudes of up to a few hundred gammas (nanoteslas). Most of the positive anomalies are clearly associated with exposures of ultramafic rocks. However, others are associated with certain volcanic and intrusive rocks. The cause or causes of still other small anomalies, such as a few within rock units mapped as the Calaveras Formation or the Shoo Fly Formation, are uncertain. In order to check the apparent association of the magnetic anomalies with mafic and ultramafic rocks and to determine whether or not other rock types might cause some of the anomalies, a number of ground profiles were run in parts of the area. Also, measurements of magnetic susceptibility of rocks were made from a set of samples from the area.

Ground Magnetic Data

A detailed ground magnetometer survey was done along a shear zone that may be part of the Bear Mountain fault zone in order to delineate local magnetic anomalies in the southwestern part of the map area (Figure 7). This survey consists of 37 northeast-trending lines ranging in length from 1000 feet to one mile. Total field magnetic readings were taken at intervals of 100 feet, and the lines were spaced at intervals of about 1000 feet in the southeastern part of the survey area and 2000 feet in the northwestern part. Plate 7 is a contour map of the data from the detailed survey with a simplified geologic map of the area.

Positive magnetic anomalies shown on Plate 7 with amplitudes of as much as 1000 gammas or more are clearly associated with mapped ultramafic rocks in this area, especially along the main mapped fault or shear zone and another parallel zone, located about 3000 feet to the northeast. However, the amplitudes of the anomalies over these rock types vary widely from line to line. Gaps and offsets in the trends of these anomalies may indicate that the ultramafic masses are discontinuous or

lenslike in shape, and may be faulted in places. In some places, anomalies in the detailed data such as on lines 25 and 33 (Figures 7, 9 and 10) indicate that the ultramafic rock apparently is continuous, even though it is not exposed on the surface.

Magnetic anomalies of moderate size were mapped along a trend approximately parallel to and about 2000 feet southwest of the main anomaly-fault trend zone (Plate 7). For example, lines 11, 19, and 21 (Figures 7, 8, and 9) show these anomalies. This anomaly trend actually may be more continuous than shown in Plate 7 because not all of the ground traverses were continued far enough to the southwest to detect it. The anomaly does extend at least from the southern part of Section 18, T2N, R12E, to the northern part of Section 12, T2N, R11E. There are no outcrops of ultramafic or other igneous rocks shown on the geologic map in this area. Nevertheless, it appears likely that this trend of anomalies represents ultramafic rocks. It is also possible that some of these anomalies as well as others in the San Andreas quadrangle could represent skarn zones or pyrrhotite-bearing rocks.

Apparent offsets in the magnetic anomalies such as those shown along the west section line of Section 36, T3N, R11E, and near the south section line of Section 7, T2N, R12E, might be caused by faults and could be favorable locations for possible mineralization. However, there is no apparent concentration of prospects or known mines in these areas on the geologic map (Clark and others, 1963).

Magnętic traverses M1, M2, and M3 were run to investigate aeromagnetic anomalies in other parts of the San Andreas quadrangle and to check the magnetic properties of rock units in the area (Figure 8). Traverse Ml is a short line less than one mile long done to check a positive aeromagnetic anomaly located in Section 15, T2N, R12E, south of Pools Station. This traverse is entirely over mapped ultramafic rocks and shows a maximum magnetic anomaly of about 1500 gammas. Five of six rock samples from this area (Samples Ml-l, through Ml-5, Table 6) appear to be ultramafic rock, probably serpentinite. These samples were found to have high values of magnetic susceptibility (average about 0.005 c.g.s. units) which shows that these rocks probably represent the cause of the observed anomaly.

Traverse M2 follows a road from south of Pools Station generally northeastward nearly to Altaville, a total of more than six miles. This magnetic profile crosses a number of different rock units including volcanic rocks, ultramafic rocks and various metamorphic rocks (Figure 7). The magnetometer profile has a sharp magnetic anomaly over ultramafic rock near Pools Station with an amplitude of about 2000 gammas, and also other local anomalies that may be associated with parts of the Copper Hill volcanics and a green schist unit. Samples of ultramafic rock (M2-5, Table 6), and basalt (M2-11 and M2-21, Table 6) all have high measured values of magnetic susceptibility, but most of the other rocks tested do not. It is likely that ultramafic and mafic rocks are the causes of the magnetic anomalies on Traverse M2.

Traverse M3 is located in Sections 20 and 21, T4N, R12E, just southeast of the town of San Andreas (Figure 7). The purpose of this line was to check a moderate-size linear magnetic anomaly in this area. The magnetic profile revealed a relatively narrow positive magnetic anomaly with an amplitude of about 2000 gammas on the western part of the profile and a relatively broad positive anomaly with an amplitude of a few hundred gammas on the eastern part of the profile. The anomaly on the eastern part of the profile corresponds to the location of the aeromagnetic anomaly, but the sharp anomaly on the western part of the profile is not indicated on the aeromagnetic map. The latter anomaly appears to be associated with a small exposure of ultramafic rock (sample M3-5, Table 6).

The broad anomaly on the eastern side of traverse M3 is located largely over exposures of the Mehrten Formation (Figure 7). Although the Mehrten Formation usually is composed at least in part of andesite fragments which are somewhat magnetic, this rock does not usually cause strong aeromagnetic anomalies. The anomaly probably is caused by rocks that underlie the surface exposures of the Mehrten Formation

Conclusions

Ground checks including magnetic traverses and magnetic susceptibility measurements of samples suggest that most of the aeromagnetic anomalies located in the San Andreas quadrangle probably are caused by ultramafic rocks and certain igneous rocks. No skarn zones or other zones containing magnetite or pyrrhotite were identified among the magnetic anomalies in the area. However, it is possible that some of the aeromagnetic or ground magnetic anomalies, whose sources were not clearly identified, might represent such rocks.

A detailed ground magnetic survey in the southwestern part of the quadrangle delineated the magnetic ultramafic and mafic rocks along fault and shear zones and indicated gaps between individual masses and apparent offsets, possibly caused by faults. Magnetic rocks that are not exposed were also located. However, no clear relationships were observed between these features and known mineral deposits or prospects in the area, except for those deposits that are related directly to the magnetic igneous or metamorphic rocks such as chromite that is found in ultramafic rocks.

SAN ANDREAS 15 MINUTE QUADRANGLE SURFACE MAGNETICSUSCEPTIBILITIES

LINE	SAMPLE	SUSCEPTIBILITIES(cgs)	DESCRIPTION
M1	MINE	.0063	gray rock w asbestos
M1	Pros Pit	.0057	gray rock w asbestos
M1	1	.0036	serpentine
M1	2	.0037	ultrabasic w asbestos
M1	3	.0045	ultrabasic black gray
M1	5	.0061	ultramafic rock
M1	6	.000009	hornblende gabbro dike
M2	1	.000017	talc schist phyllite
M2	2	.000026	dark green schist
M2	3	.000043	green phyllite
M2	4	.000043	gram schist
M2	5	.0029	serpentine
M2	6	.000034	gray green schist
M2	7	.000034	gray green schist
M2	8	.000009	conglomerate
M2	9	.00024	gray meta-tuff
M2	10	.000026	greenstone
M2	11	.0045	dark gray basalt
M2	12	.000026	tan schist
M2	13	.000034	tan slate
M2	14	.000009	gray quartizite(?)
M2	15A	.000017	gray phyllite
M2	15B	.000009	slate
M2.	16	.000009	tan meta-tuff
M2	17	.000026	greenstone
M2	18	.000034	gray green homfels
M2	19	.000009	gray green quartzite?
M2	20	.000043	basalt
M2	21	.00012	basalt
M2	22	.000034	gray phyllite
M2	23	.000017	tan slaty schist
M2	24	.000034	gray phyllite
M2	25	.000078	gray meta-basalt
M2	26	.000034	gray green phyllite
M2	27	.000017	gray slate
M2	28	very small	gray slate
M2	29	.000017	not recorded
M2	30	.000026	gray slate or phyllite
M2	31	.000017	gray slate
M2	32	.000017	tan slate w quartz
M2	33	.000095	gray hornfels
M2	34	.000017	gray green phyllite
M2	35	.000052	light green slate
M2	36	.000043	tan-gray slate
M2	37	.000009	light tan slate
M2	38	. 000052	tan meta-tuff
M2	39	.000039	greenstone
M3	1	.000060	gray phyllite
M3	2	.000060	gray hornfels/phyll
M3	3	.000034	green phyllite/schist
M3	4	.000034	green phyllite/schist
M3	5	.00040	brown/black serpentine

Table 6. Magnetic susceptibilities of rocks present within the San Andreas 15-minute quadrangle.

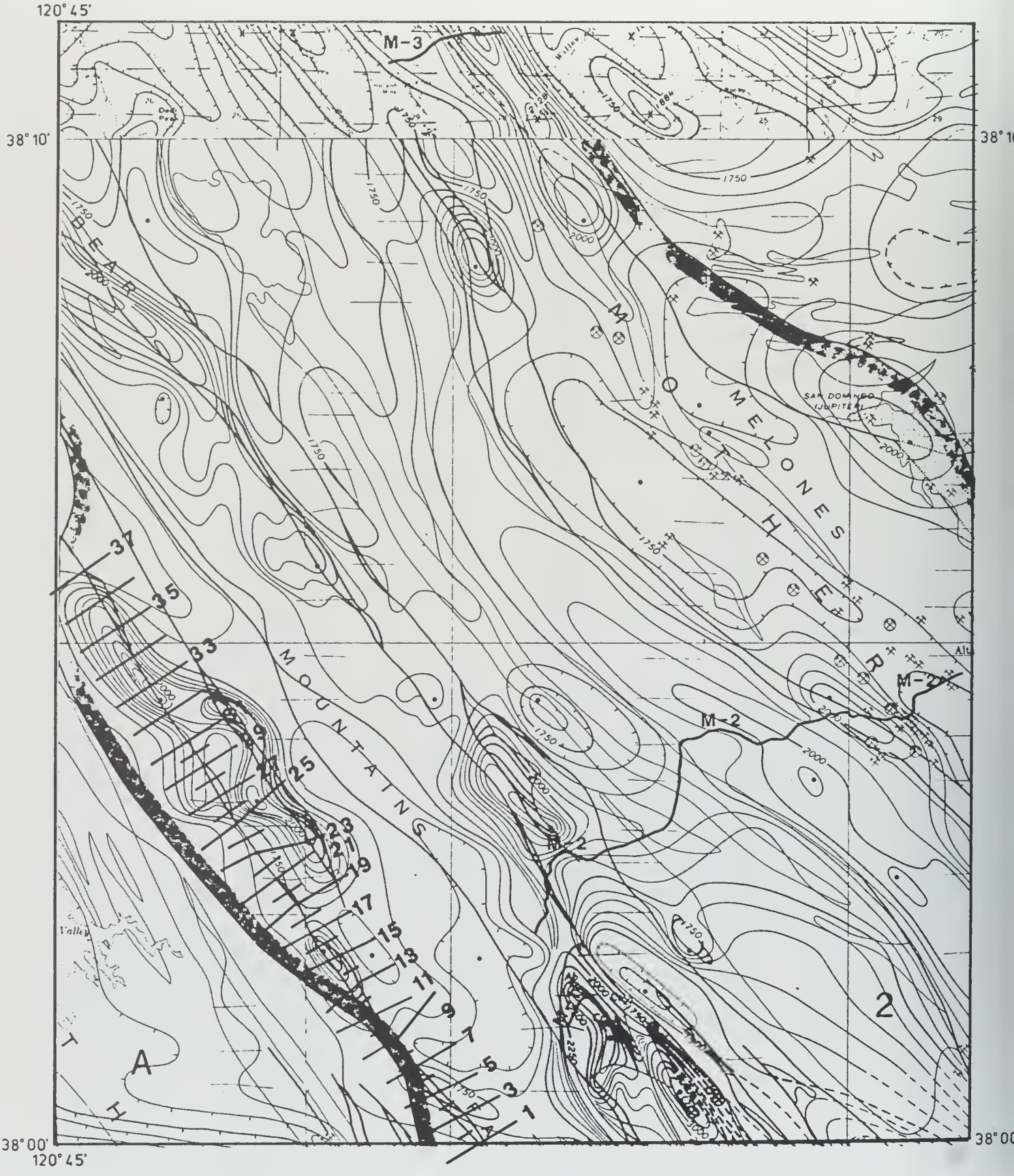

Figure 7. Aeromagnetic map of the San Andreas 15-minute quadrangle showing location so ground magnetic traverses.

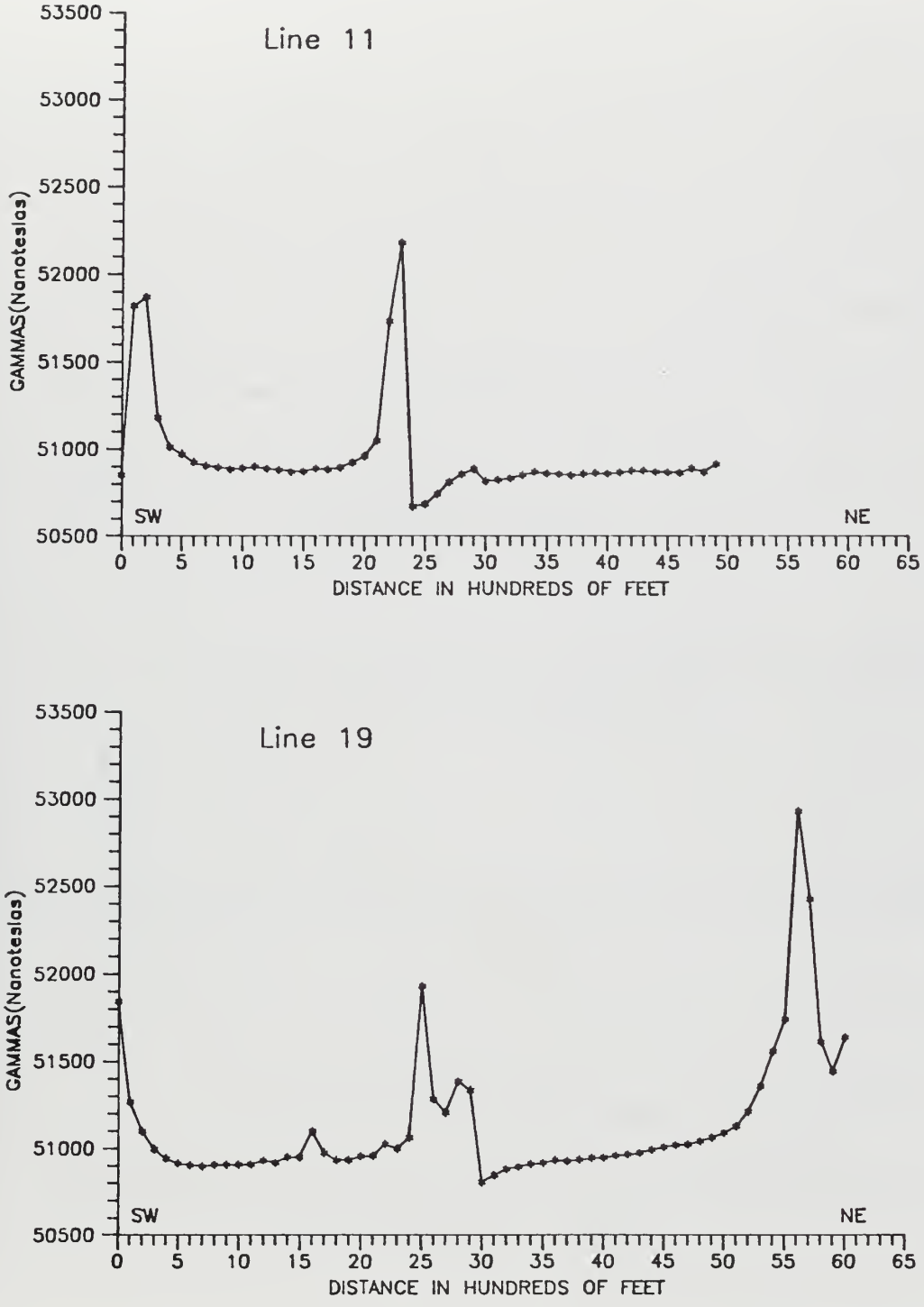

Figure 8 Ground magnetometer profiles for lines 11 and 19, San Andreas, quadrangle, Calaveras County, California

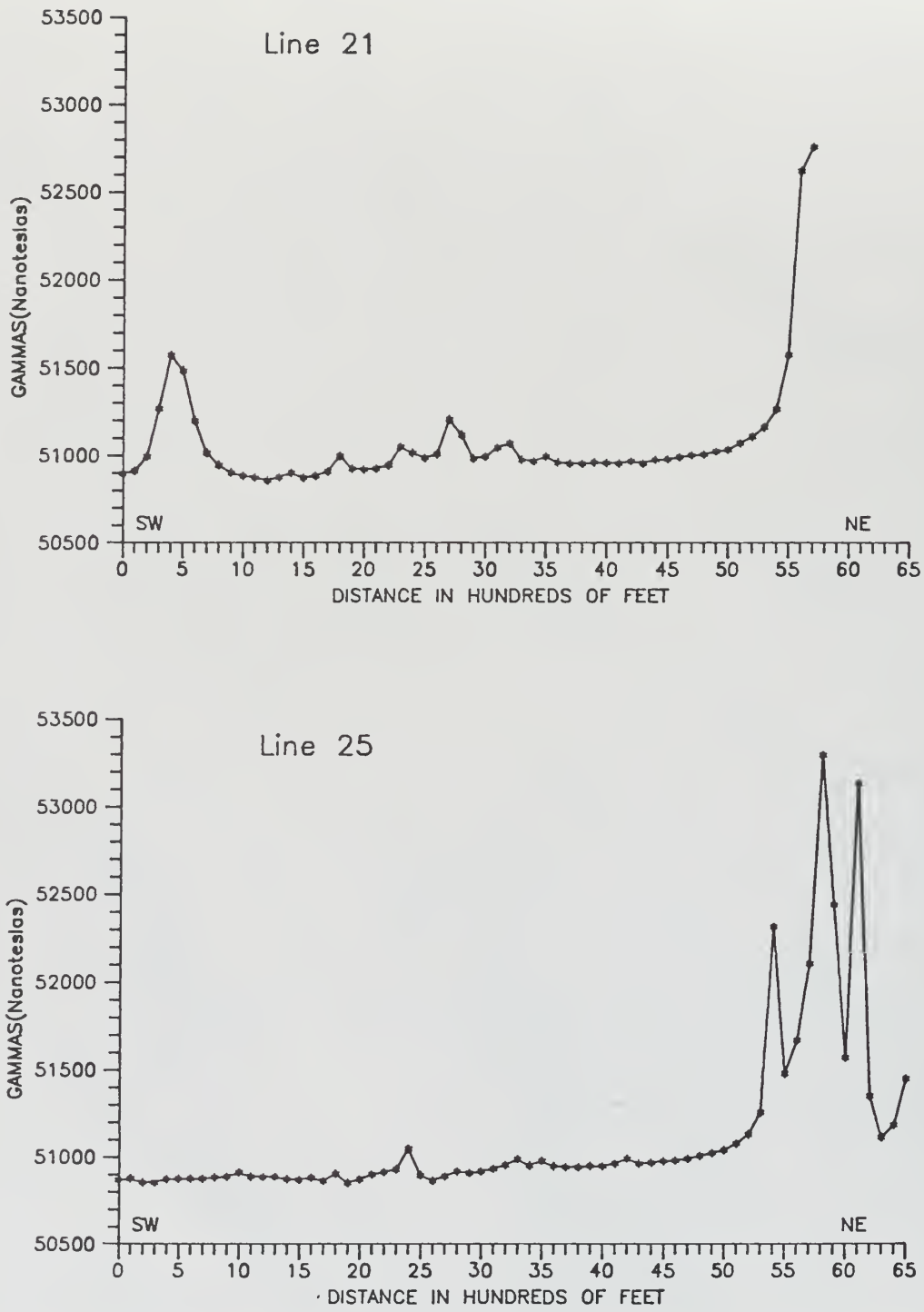

Figure 9. Ground magnetometer profiles for lines 21 and 25, San Andreas Quadrangle, Calaveras County, California.

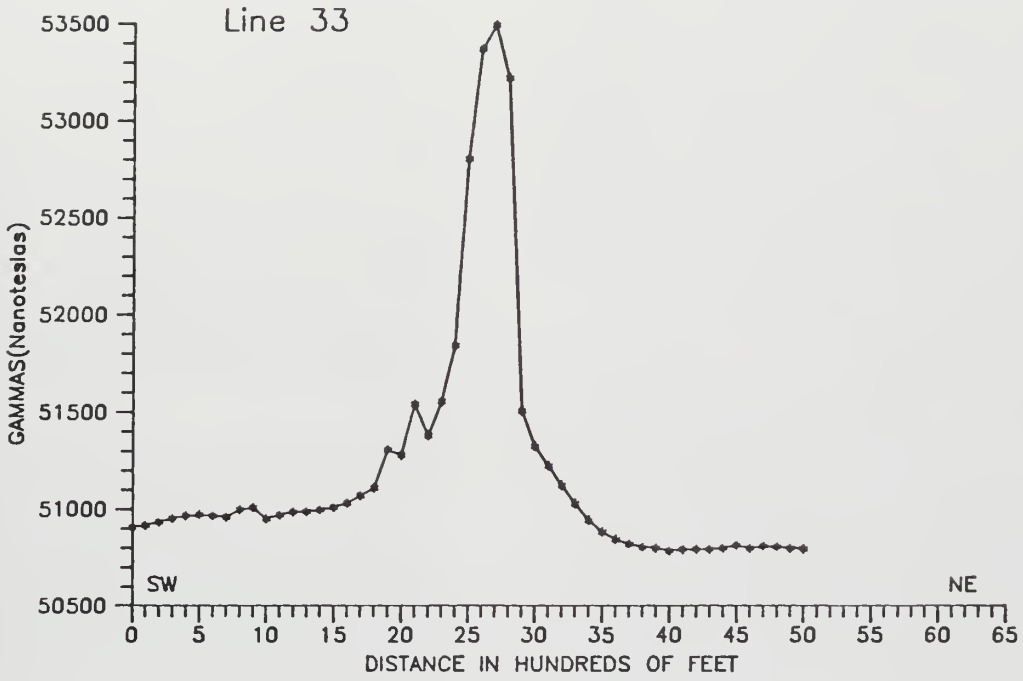

Figure 10. Ground magnetometer profiles for lines 33, San Andreas quadrangle, Calaveras County, California.

PART III - MINERAL RESOURCE ASSESSMENT

MINING HISTORY

Soon after James Marshall's historic gold discovery at Coloma, large numbers of gold seekers arrived in the San Andreas area to work the streams. By the end of 1848 the entire region had been fairly well explored with such mining towns as Angels Camp, Carson Hill, Dogtown, Melones, Murphys, and Vallecito springing up almost overnight. The rich surface placers which sustained the initial gold rush were soon exhausted. Hydraulic and drift mining along with lode-gold mining then became the chief source of gold. Although widespread gold mining activity in the area diminished after the 1880's, significant yield is recorded from several mines at various times up to 1942, when gold mining was terminated by Congressional Order L-208. Although some development work and production occurred in the mid-1950's, interest in gold mining in the region was low until gold prices reached $800 in 1980. Since then, much prospecting, exploration and some production from several mines, such as the Carson Hill, Royal, Altaville, and Gold Cliff, has occurred.

Copper, limestone, talc, manganese, iron, silica, and chromite have also been mined at various times within the study area. During the Civil War years exploration and mining of copper brought a good deal of mining activity to the Copperopolis area near the southwestern portion of the quadrangle. It was during this time that the area around Copperopolis became the leading source of copper in the State.

In 1925 the Calaveras Cement Company built a plant in San Andreas and began mining limestone from a number of deposits in the area. The plant is currently shut down, but a small staff maintains the plant so that it can return to production if needed. From the 1950's until 1980, Calaveras Cement was the major mining industry in the quadrangle employing over 400 people.

At the present time, Western Source Inc. operates a talc quarry southeast of Angels Camp. The talc is used in insecticides, paints, plastics, and roofing products as a filler additive. Also some manganese, iron, silica, and chromite has been produced from small isolated deposits in the quadrangle, principally during both World Wars.

An annotated listing of known historic mines and prospects in the project area is presented in Appendix B.

MINERAL LAND CLASSIFICATION

The area represented by the San Andreas 15-minute quadrangle is classified for the presence or likely occurrence of metallic and industrial mineral resources. Consideration is given to all non-fuel minerals of economic importance (exclusive of sand, gravel, and common rock) by determining what genetic classes of mineral deposits (Table 7) are likely to exist in the area. Only those genetic classes for which direct or indirect evidence indicates the presence or likely occurrence of significant deposits are addressed in the mineral land classification report. However, other types of deposits may exist which, because of lack of evidence, are not presently recognized.

Of the nine genetic classes and the industrial minerals group listed in Table 7, five are judged to be, or likely to be, present in the project area. These are as follows:

1. Deposits formed by hydrothermal processes (base and precious metals) - Plate 2.
2. Deposits formed by volcanogenic processes (copper, zinc, gold and associated metals) - Plate 3.
3. Industrial mineral deposits formed by diverse processes (carbonate rock, asbestos, talc, and silica) - Plate 4.
4. Deposits formed by magmatic concentration (chromite) - Plate 5.
5. Deposits formed by residual and mechanical concentrations (placer gold) - Plate 6.

Mineral land classification is based on recognition and delineation of geologic environments present in an area and determination of those genetic types of mineral deposits likely to be hosted in those environments. In all, nine distinct genetic types of mineral deposits are recognized: Industrial mineral deposits are classified as a group rather than on a genetic basis.

Detailed descriptions of areas classified for these mineral resources are presented below. A map explanation and mine/prospect index is provided in Plate 1.

Table 7. Genetic classes of mineral deposits

GENETIC CLASSES OF MINERAL DEPOSITS
1. Magmatic concentration deposits
2. Contact metasomatic deposits
3. Hydrothermal mineral deposits (exclusive of volcanogenic deposits)
4. Exhalative volcanic deposits (volcanogenic)
5. Deposits formed by sedimentation
6. Deposits of bacteriogenic origin
7. Evaporates
8. Residual and mechanical concentrations
9. Deposits formed by metamorphism
10. Industrial mineral deposits formed by diverse processes

AREAS CLASSIFIED FOR HYDROTHERMAL MINERALIZATION

Ore deposits formed by hydrothermal processes represent a major source of metallic mineral resources and to a lesser extent, non-metallic ones. The metals include: gold, silver, lead, zinc, copper, mercury, antimony, tin, tungsten, molybdenum, vanadium, and numerous minor elements. The more common non-metallic minerals include: kaolin, alunite, barite, zeolite, and various types of clay. Of greatest economic significance in the study area is gold.

Evidence of hydrothermal mineralization is widespread throughout the study area. In some areas hydrothermal mineralization shows considerable continuity and, as a consequence represent attractive exploration targets. They are recognized by their characteristic hydrothermal mineral assemblages localized along regional-scale fault and shear zones.

Mineral land classification of areas with hydrothermal mineralization is presented on Plate 2. Mineral resource zones for these areas are denoted by the superscript "h" (e.g., MRZ-3$^{(h)}$ (see **Mineral Resource Zone Categories** section, Part I, for MRZ explanation). For purposes of discussion, individual areas are assigned reference numbers (e.g., MRZ-3a$^{(h-1)}$).

Areas Classified MRZ-2a$^{(h)}$

Two locales within the San Andreas quadrangle are classified as areas containing significant indicated and/or measured precious base metal resources of hydrothermal origin (MRZ-2a$^{(h)}$).

Mountain King-Royal Mine Area, MRZ-2a$^{(h-1)}$: Encompasses land in Salt Spring Valley near Copperopolis. Gold mineralization occurs along the Hodson fault zone where Salt Spring Slate to the west is juxtaposed against Copper Hill Volcanics to the east. The deposits occur in interbedded greenstones, schists and slates of the Copper Hill Volcanics which dip 30° to 70° to the northeast and are locally cut by northeast dipping thrust faults. The mineralization as reported by Clark and Lydon (1962) is at least 500 feet thick and nearly 4,000 feet long. Occurring in vein quartz and in bodies of "gray ore" of varying dimensions within the Hodson fault zone.

The dominant structural features of the Hodson District are northwest trending faults which are parallel to sub-parallel to regional schistosity and bedding. Several different types of structures have been identified - the most important being the Hodson fault, which is the major ore controlling feature of the district. This structure is a west-verging thrust fault which trends N25°-45°W; 25°-45°NE. In general, it thrusts greenstone over metasediments and, where structural preparation was most intense, appears to be the loci of gold mineralization. Several hundred meters east of the Hodson fault is a wide zone of strong shearing and mylonitization. It trends approximately N10°-15°W, dips steeply to the east, and is characterized by elongate lenses of serpentinite along its trend, along with mylonite and fault gouge. Its relationship with the Hodson fault is not fully understood at this time. Late, eastwest trending post mineral cross faults have also been identified.

Mineralization and alteration are distinct and different in all three of the currently identified reserve areas. In general, metavolcanic rocks in all three areas tend to be more altered than metasediments. Iron carbonate is a ubiquitous consituent of altered greenstones, imparting a grayish hue to the rocks, hence the oldtimers' terms, "gray ore".

Gray ore occurs at greenstone which has been altered by carbonate metasomatism to quartz-ankerite-sericite-mariposite rock containing disseminated free gold and auriferous pyrite. Gray ore also occurs as pyritized silicified metatuffs, as observed at the Mountain Pit.

Gold is present as inclusions and veinlets within sulfides as silver poor electrum. Most of the gold is associated with pyrite, the remainder found with sphalerite, tetrahedrite, other sulfides, and as free gold. Sulfide content rarely exceeds 5% and is usually in the range of 1-2% in ore grade zones. Silver content of the electrum ranges from 10% to 30%. The deposits, as a whole, have gold to silver ratios between 1:1 to 4:1.

Ore reserves reported by Mother Lode Gold Mines Consolidated in 1988 were 9.07 million tons averaging 0.070 ounces of gold per ton and an additional 1.44 million tons averaging 0.025 ounces of gold per ton.

The origin of the Royal-Mountain King deposit is problematic. Although the deposit occurs in the volcanogenic terrain of the West Belt, its style of mineralization is more typical of the Mother Lode belt, as suggested by the apparent structural control exerted by the Hodson fault zone and gold mineralization occurring in quartz veins and gray ore.

Carson Hill Mine Area, MRZ-2a$^{(h-2)}$: The Carson Hill Mining District, site of the Carson Hill Mine, is noted for its structural complexity. It has been generally described by Clark and Lydon (1962) as the area of convergence of the northwest striking Calaveras vein system with the north to northwest striking Bull vein in intensely folded and faulted amphibolite, augitic tuff, breccia and chlorite schist. The Calaveras vein system has an average thickness of 10 to 15 feet but in places is up to 100 feet thick. According to Knopf (1929, p. 74) the vein yielded 0.19 ounce gold per ton in 1919-1920. The Bull vein ranges from 1.5 to 40 feet in thickness and rarely contained more than a seventh of an ounce of gold per ton. It splits at Carson Hill and continues south as the Stanislaus and Adelaide veins. Wallrock alteration in the Carson Hill area is pervasive and primarily consists of ankerite-mariposite rock and auriferous quartz-ankerite-talc-sericite schist.

Stratigraphic units exposed on the property generally strike northwesterly and dip steeply to the east . Foliation trends vary from N10°W to N40°W with steep dips to the east. Major rock units include hornblende andesite, metavolcanic rock of a more mafic composition, carbonaceous schist, talc schist, sericite schist, sericite chlorite schist, serpentinite, quartz-carbonate rock, including mariposite, and massive milky white quartz vein. In addition to the massive vein exposures, there are a number of economically significant, gently dipping

quartz veins ("flat veins") that occupy a series of thrust faults exposed on the property and numerous northeast striking, northwest dipping veins. It has been observed at the Carson Hill mine that the richer ore zones are present in rocks cut by numerous quartz stringers and that the ore grade in these zones tend to increase nearer the mineralized fault splay occupied by the massive quartz vein. Within these ore zones, gold occurs in disseminated form, both in association with iron sulfide and in microscopic native form.

Carson Hill Gold Mining Corporation has mineable ore reserves of about 16 million tons grading at 0.046 ounces of gold per ton. Thirty thousand tons of rock per day are being mined by private contractor. The ore is processed using cyanide heap leach with a 75% recovery rate.

Areas Classified MRZ-2b$^{(h)}$

Two areas are classified as containing significant inferred precious and base metal resources of hydrothermal origin.

Mother Lode Gold Belt, MRZ-2b$^{(h-1)}$: The 22-mile long extention of the Mother Lode belt through the San Andreas quadrangle is classified as MRZ-2b$^{(h)}$. The belt as a whole, rather than individual mines or veins, was classified MRZ-2b because field evidence and historic mining activity provide ample evidence for the overall continuity of a major mineralization system in which ore grade material is not likely to have been depleted. This reasoning is based on: (1) the high likelihood for the existence of blind ore bodies; (2) the knowledge that some subeconomic mineralization is likely to become enriched at depth; (3) the well-known vertical persistence of the veins; (4) the fact that some of the mines were involuntarily closed in World War II by the War Production Board Order L-108, issued in October 1942; and (5) the fact that current mining and milling technology allow production from low-grade disseminated deposits known to be present within the belt. Additional information regarding reserves of individual mines could result in portions of the belt being upgraded to the MRZ-2a$^{(h)}$ category.

The Mother Lode belt consists of a system of gold-bearing quartz veins that occupy fault and fracture openings in an area situated within and slightly to the west of the Melones fault zone. Although Mother Lode mineralization has been regionally recognized in a wide range of host rocks, the deposits in the study area occur mainly in metamorphosed sedimentary and volcanic rocks of Late Jurassic age Mariposa Formation and Mariposa equivalent rocks (Schweickert and Bogan, 1983).

Knopf (1929, p. 23) has described the general hallmarks of Mother Lode gold deposits. Throughout the regional extent of the belt, they occur in a wide range of host rock types. Ore generally occurs in quartz veins in the northern part of the Mother Lode belt and as auriferous greenstone ("gray ore") and mineralized schist with thick barren quartz veins in the southern portion of the belt. Sulfide mineralization in the veins deposits rarely exceeds 1 to 2 percent. The dominant sulfide is pyrite with some arsenopyrite and occasional minor amounts of sphalerite, galena, chalcopyrite and tetrahedrite. Mineralized greenstone (gray ore) described earlier by Knopf (1929, p. 33) occurs in irregular-shaped zones usually adjacent to quartz veins. Mineralization generally consists of fine-grained ankerite with subordinate amounts of sericite, albite and quartz and up to 3 or 4 percent pyrite and arsenopyrite in breccias and tuffs of augitic greenstone. Similar mineralization is also recognized by Knopf (1929, p. 34) in amphibolite and chlorite schist where the schist is replaced by ankerite and pyrite between quartzitic and ankeritic veinlets, forming irregular- shaped bodies up to 100 feet wide. This relationship is especially prominent at the Gold Cliff mine (mine location 90).

The largest producing gold deposits in the study area are located in the southern portion of the Mother Lode belt and include Carson Hill area mines and the Angels Camp Mining District.

The Mother Lode belt continues northwest from Carson Hill as delineated by a nearly continuous string of lode gold mines, to the Angels Camp Mining District. According to Clark and Lydon (1962), the largest producer in the district included the Utica Mine which produced $17 million gold before 1915 and the Gold Cliff Mine with $2.8 million gold produced between 1884 and 1920 as well as the Lightner Mine, which produced more than $3.0 million in gold between 1896 and 1915, and others with lesser amounts of production. (Note: The price of gold was $20.67 a fine ounce until 1933, when it was increased to $25.56. The figure rose to $34.95 the following year and again, to $35, in 1935). These mines followed subparallel northwest trending vein systems approximately 3,000 feet apart on the surface which meet at a depth of 2,700 feet (Logan, 1934, p. 140) beneath the town of Angels Camp. Clark and Lydon (1962) describe the ore bodies in the Utica vein system as lenticular quartz and calcite veins and highly sheared amphibolite, chloritic, and talcose schist. Ore grade at the Utica mine is reported to have varied considerably, but mill-head averages were 0.71 ounce per ton, according to Logan (1934, p. 151). The Madison and Gold Cliff mines worked the vein system on the west side of Angels Camp. The Gold Cliff ore body is 6 to 10 feet thick and locally up to 100 feet and generally consists of auriferous, pyritized quartz veins and veinlets in pyritized chloritic and amphibolitic schist. The average ore grade ranged from .10 to .25 ounce per ton in 1914 (Knopf, 1929, p. 71). During the course of this study, the Gold Cliff mine was the site of active subsurface exploration activity.

Big Seven Mine Area, MRZ-2b$^{(h-2)}$: The area encompassing the Big Seven mine (mine locality 39) is classified MRZ-2b. The deposit at this locale occurs within dense amygdaloidal basalts, dark gray slates, talc-chlorite schist and phyllites of the Copper Hill Volcanics. It is enclosed within vertically dipping shear zones which strike N40°W. At the northern-most of three shafts shown on Plate 1, mine workings expose a zone of greenstone which has been kaolinized over a width of at least 100 feet, and contains a sheared, silicified and pyritized zone at least 25 feet wide (but approximately 6 to 10 feet wide elsewhere on the property). The degree of

kaolinization is mostly moderate, but in places is so intense that all semblance of bedding is destroyed. The kaolinized and silicified zones respectively contain, from feeble amounts to several percent disseminated, fine- to medium-sized pyrite (limonite often pyrite) with trace amounts of galena and malachite (possibly from chalcopyrite). The greatest degree of pyritization occurs along fractures in the kaolinized and silicified zones.

The mineral deposit appears to be faulted out several hundred feet northwest from the northern shaft. It can easily be traced approximately 1,000 feet along strike to an area just below the southern most shaft where it may pinch out or possibly be faulted out. Although the silicified zone exposed in the northern most shaft was more extensively pyritized surface exposure on the property, grab samples which were assayed for gold and silver showed higher values in the middle shaft area. A sample collected in the silicified zone at the middle shaft carried 2.43 oz/ton silver and 0.062 oz/ton gold. Samples collected at the northern shaft in the kaolinized and silicified zones respectively contained 0.45 oz/ton silver - 0.014 oz/ton gold, and 0.74 silver - 0.042 oz/ton gold.

As previously noted, the Big Seven deposit occurs along a northwest trending shear zone which possibly is related to a more extensive regional shear zone mapped by Clark, Stromquist and Tatlock (1963). During the present study it was noted that the prominent hill, located approximately 500 feet northwest of the Big Seven deposit, is composed of coarse grained diorite. The intrusive margin of this small pluton is cut by small veinlets of epidote of deuteric or hydrothermal origin.

The origin of the Big Seven deposit has not been conclusively demonstrated. Although it is located in the West belt terrain, the form and mineralogy of the deposit indicate that it is not of volcanogenic origin. Similarly, although the deposit is structurally controlled, it is not likely to be of Mother Lode origin as it is located at least 7 miles west of the Melones fault zone, and the presence of galena, chalcopyrite, and sphalerite within vein quartz and silicified rock are not characteristic of Mother Lode mineralization. As the Big Seven is in close proximity to a mafic pluton, its likely local mineralization is related to the emplacement of the pluton where mineralizing fluids were channeled along a zone of structural weakness, such as a regional shear zone.

Areas Classified MRZ-3a$^{(h)}$

Six areas in the San Andreas quadrangle are classified as being areas underlain by geologic settings within which undiscovered mineral resources similar to known deposits in the same producing district or region may be reasonably expected to exist (hypothetical resources).

Gourley Reservoir Area, MRZ-3a$^{(h-1)}$: This are is situated between two apparent branches of the Mother Lode gold belt. Although no gold mines or prospects are recognized in the zone, its setting within the Mother Lode belt suggests a moderate to high potential for the presence of undiscovered gold resources.

West of Mother Lode Belt Area, MRZ-3a$^{(h-2)}$: The one-to two-mile strip of land lying along the western margin of the Mother Lode belt is classified MRZ-3a$^{(h)}$. The presence of a dozen or so historic gold mines and prospects along the zone indicate that gold mineralization occurs sporadically and discontinuously. Unlike the regional-scale ore control system characterizing the Mother Lode belt, gold mineralization within this area appears to be controlled by isolated, localized structures.

East of Mother Lode Belt Area, MRZ-3a$^{(h-3)}$: The one-to two-mile strip of land lying along the western margin of the Mother Lode belt is classified MRZ-3a$^{(h)}$. The presence of half a dozen or so historic gold mines and prospects along the zone indicate that gold mineralization occurs sporadically and discontinuously. Unlike the regional-scale ore control system characterizing the Mother Lode belt, gold mineralization within this area is most likely controlled by isolated, localized structures.

East of Gold Belt Area, MRZ-3a$^{(h-4)}$: This area includes clusters of mines and prospects situated east of the Melones fault zone in terrain dominated by the Calaveras Complex. The prospects and mines consists of quartz veins which carry varying amounts of gold. Mineralization occupies fault and fracture openings which generally follow the west to northwest foliation of the graphitic schists, slates and quartzites typically found in the Complex. The veins typically are less than 5 feet thick and are composed of dense milky white vein quartz carrying free gold with minor auriferous pyrite. Wallrock alteration typically occurs in close proximity to the veins. Fragmented country rock occurs in some of the veins and is characterized by having rounded, cloudy margins (as at locality 211), suggesting they may have been formed at a relatively high temperature. With exception of the San Antonio Camp area, where local landowners' mine maps show systems of quartz veins extending over 1 mile along strike, the otherwise scattered distribution of mines in the Calaveras terrane is suggestive of the discontinuous nature of these vein quartz deposits.

In addition to the scattered vein deposits, two prominent shear zones within the Calaveras terrain show evidence of hydrothermal alteration. One trends northwest approximately 1 mile southwest of Mountain Ranch, and the other trends approximately eastwest near Fricot Ranch, through Calaveritas, then northwest around a granodiorite pluton, becoming parallel and in close proximity to the Mother Lode belt (Figure 6). The zones are marked by pronounced schistosity and lenses of talc-ankerite-antigorite schist (L.D. Clark,' 1970). Cavity filling gold deposits including the Basco, Chaparral and Economic deposits (mine locations 29, 56 and 74) are examples of gold- bearing deposits that are present along this southerly shear zone. Although the form of these deposits, mineralogy and wallrock alteration are similar to deposits in the Mother Lode belt, a genetic relation is not apparent.

Big Seven Ridge Area, MRZ-3a$^{(h-5)}$: This area envelopes the Big Seven mine area, which has been classified MRZ-2b$^{(h-2)}$ (Plate 2). The area is judged to have moderate potential for the presence of additional gold resources associated with the Big Seven mine deposit.

Hodson Mining District, MRZ-3a$^{(h-6)}$: This area envelopes the Hodson mining district which includes the Royal Mountain-King mine, MRZ-2a$^{(h-1)}$. The area is judged to have moderate to high potential for the presence of additional gold resources.

AREAS CLASSIFIED FOR DEPOSITS FORMED BY VOLCANOGENIC PROCESSES

A segment of the Foothill Copper-Zinc Belt of the western Sierra Nevada extends through the southwestern part of the San Andreas quadrangle. The belt is defined by widespread occurrence of polymetallic sulfide deposits associated with felsic pyroclastic rocks in the Gopher Ridge and Copper Hill Volcanics, and the Smartville Volcanic-Plutonic Complex (Kemp, 1982). The deposits are strata-bound, commonly stratiform, accumulations of iron sulfides, mainly pyrite, mixed with various amounts of chalcopyrite, sphalerite, galena, and precious metals. Mineralization is thought to have formed by subaqueous hydrothermal exhalative systems that vented metal-rich fluids at a sea water-rock interface. Most of the deposits are similar in mineralogy, morphology, and metal zoning to the Kuroko-type (Zn-Pb-Cu) and Cyprus-type (Zn-Cu) volcanogenic deposits (Kemp, 1982). Ore grades within the deposits commonly average 2 to 5 percent copper, 2 to 15 percent zinc, 1 to 2 percent lead, 2 to 5 oz/ton silver, and 0.01 to .05+ oz/ton gold. Some are enriched in precious metals with sulfide mineralization commonly assaying in excess of 0.10 oz/ton gold and 10 oz/ton silver (Jenkins, 1948).

Mineral land classification of the San Andreas quadrangle with respect to volcanogenic mineral deposits is presented on Plate 3. Mineral Resource Zones for this class of deposits are denoted by the superscript "v" (e.g. MRZ-3a$^{(v)}$) .

Areas Classified MRZ-3a$^{(v)}$

These are areas underlain by marine volcanic rock sequences in which undiscovered volcanogenic ore deposits, similar to known deposits in the same producing district or region, may be reasonably expected to exist (hypothetical resources). Areas underlain by the Gopher Ridge, and Copper Hill Volcanics are assigned to the MRZ-3a$^{(v)}$ category because they are the host rocks for known volcanogenic deposits of the Foothill Copper-Zinc Belt and additional deposits are, therefore, likely to exist.

Foothill Copper-Zinc Belt, MRZ-3a$^{(v-1)}$: Encompasses a 4 mile wide, northwest trending strip of land underlain by metavolcanic rocks of the Late Jurassic Copper Hill Volcanics. Two known massive sulfide deposits are located in the copper-zinc belt extending through the area.

Areas Classified MRZ-3b$^{(v)}$

These are areas that may contain undiscovered metallic resources of volcanogenic origin that may occur either in known types of deposits in favorable geologic settings where discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential (speculative resources).

Hogback Mountain Area, MRZ-3b$^{(v-1)}$: The area underlain by the Logtown Ridge Formation is classified MRZ-3b$^{(v)}$ It includes volcanic deposits that are favorable host rocks for the occurrence of volcanogenic deposits.

AREAS CLASSIFIED FOR INDUSTRIAL MINERALS

Industrial minerals include earth materials that are of economic value, exclusive of metallic ores, fuels, and gemstones. Those known to be present in the area include carbonate rock, talc, silica, and asbestos. The superscript "i" is used to denote areas classified for the industrial minerals (e.g. MRZ- 3a$^{(i)}$). See **Mineral Resource Zone Categories** section for explanation. For purposes of discussion, individual classified areas are assigned reference numbers (e.g. MRZ-3a$^{(i-3)}$). Mineral land classification of the San Andreas quadrangle with respect to industrial mineral deposits is presented on Plate 4 and discussed below.

Areas Classified MRZ-2a$^{(i)}$

These are areas that contain deposits of industrial minerals where geologic data indicate that significant measured or indicated resources of rock suitable for use as a marketable product(s) are present. Only one deposit within the study area is known to meet the criteria for this classification and is described below.

Red Hill Talc Quarry, MRZ-2a$^{(i-1)}$: The Red Hill Talc quarry is the site of an active mine operated by Western Source, Inc. The talc is hauled by truck to the company crushing and processing plant located at Toyon, a distance of 12 miles. The steeply dipping, massive white talc deposit is attributable to hydrothermal alteration of gray, carbonaceous quartz mica schist which has previously been mapped as ultramafic rocks. Although the quality of the talc is generally high, the cleanest talc occurs along the footwall contact, and the lowest grade occurs along the hanging wall, where local iron contamination is common.

The demonstrated quality of the talc deposit and the substantial amount of rock remaining at the quarry site offer sufficient evidence that the property meets the criteria for inclusion within the MRZ-2a mineral land classification category.

Areas Classified MRZ-2b$^{(i)}$

These are areas that contain deposits of industrial minerals where geologic information indicates that significant inferred resources of rock suitable for use as a marketable product are present. Several areas underlain by carbonate rock and a property containing talc are classified MRZ-2b(i). These are described below.

Kentucky House Limestone Deposits, MRZ-2b$^{(i-1)}$: The Calaveras Cement Kentucky House deposit is located 2 miles south of San Andreas on Pool Station Road. It occurs as two lenses that trend N45°W to N30°W and are 400 to 500 feet wide and up to 2,000 feet in length. To the east, interbedded with the high-calcium, fine-grained, medium to dark gray limestone, are beds of sheared, hydrothermally altered dolomite which locally

contain magnesite. Quartz-diorite dikes cut the limestone and adjoining metasedimentary rocks in this area. This deposit has been worked since 1922, but is presently idle. Some of the adjoining metasedimentary rock, which is referred to as "shale", is mined for the necessary silica, alumina, and ferric oxide required in making cement. Adjoining the property is the Genstar Cement, Inc. (Calaveras Cement) plant which is currently idle but maintained in working condition by a small permanent staff. The Kentucky House deposit was discovered in 1922 and has been in nearly continuous production from 1926 to 1980(?). The cement manufactured from this deposit has been used in the construction of the Pardee Dam, San Francisco-Oakland Bay Bridge, Friant Dam, military bases during and since World War II, the Delta-Mendota Canal, and the Folsom Dam.

Calaveritas Limestone Deposits, MRZ- 2b(i-2): The Calaveras Cement Company's Calaveritas limestone deposit is located 1 mile northeast of the town of Calaveritas in the westernmost body of limestone. The bodies are massive, coarsely crystalline, carbonate rocks which range from white to gray in color (Clark and Lydon, 1962). Generally the large bodies of carbonate rock contain high-calcium limestone, and the smaller ones are largely dolomitic (Clark and Lydon, 1962). They occur as east trending, complexly folded and faulted masses, some measuring in excess of 1,200 feet in length and about 800 feet in width. Calaveras Cement Company's Quarry No. 4 contains small interbeds of schist in the limestone and these supply some of the oxides needed for making cement. This means that a smaller amount of "shale" is mined from the nearby country rock for the production of cement.

Chemical analysis of six samples collected from two carbonate bodies reported on by Clark and Lydon (1962) and Fuller (personal communication), indicate that overall, these deposits are of high purity and of relatively uniform composition (Table 8).

Cave City Carbonate Rock Deposits, MRZ-2b(i-3): The Cave City deposit is located near the town of Mountain Ranch. The deposit forms an elongate body of carbonate rock striking N45°W and dipping 60 to 70° northeast. The deposit ranges from 600 to 1,500 feet in thickness and extends 4 miles to southeast of Mountain Ranch. In places the deposit is overlain by auriferous gravels which were mined during the gold rush.

The limestone ranges from white to gray in color and in many places is brecciated and recemented. The limestone is coarse-grained and the dolomite and dolomitic limestone is fine-grained. The most prominent outcrops of this deposit usually are dolomite (Clark, 1954, p. 7). Portions of the limestone from the Adobe Gulch area have been sampled by Calaveras Cement Company. Sample analyses furnished by the company are shown on Table 9.

Table 8.

Chemical analyses of samples collected from the Calaveritas Limestone deposits by Calaveras Cement Company (Clark and Lydon, 1962, p. 98)

Sample No.	SiO_2	Fe_2O_3	Al_2O_3	$CaCO_3$	$Mg\ CO_3$
1.	0.20	0.09	0.18	98.90	0.69
2.	0.69	0.13	0.27	98.49	0.44
3.	0.56	0.09	0.30	98.33	0.73
4.	3.53	0.27	0.41	94.96	0.81
5.	1.61	0.45	0.67	96.19	1.10
6.	1.50	0.50	0.70	94.00	2.00

Table 9.

Chemical analyses of samples collected from the Cave City Carbonate Rock deposit by Calaveras Cement Company (Clark and Lydon, 1962, p. 102)

Sample No.	SiO_2	Fe_2O_3 & Al_2O_3	$CaCO_3$	$Mg\ CO_3$
1.	0.91	0.26	81.71	17.72
2.	0.27	0.38	75.88	23.59
3.	0.37	0.72	80.79	18.27
4.	0.11	0.20	93.75	6.73
5.	0 .36	0.45	94.02	5.99
6.	0.21	0.25	96.96	3.30

Areas Classified MRZ-3a$^{(i)}$

These are areas characterized by geologic environments within which undiscovered mineral resources, similar to known deposits in the same producing district or region, may reasonably be expected to exist (hypothetical resources). There are several such areas within the study area which meet the criteria for classification into this category. These are described below.

Bear Mountains Serpentinite Belt, MRZ-3a$^{(i-1)}$: Ultramafic rocks in the study area are exposed intermittently along the Bear Mountain fault zone. Although there are no producing asbestos mines and only one producing talc mine in the study area, several deposits have been sporadically mined in past years. Currently, talc and asbestos are produced from ultramafic rocks exposed elsewhere in the foothill region of the Sierra Nevada.

In the Bear Mountain serpentinite belt, serpentine, which is the host rock of chrysotile asbestos, is abundant. The asbestos is in the cross-fiber seams and veinlets which appear as stockworks in the serpentine. Most veinlets are an inch or less in thickness and a few feet in length. The deposits consist of those portions of the serpentine which contain sufficient asbestos veinlets and seams to be a commercial value (Clark and Lydon, 1962).

Six miles south of the San Andreas quadrangle along the Bear Mountain serpentine belt is the American deposit, which has produced asbestos since 1961. Within the quadrangle and along the same trend is the Turner and Lloyd deposit which was worked prior to 1925. At this deposit the chrysotile asbestos forms stockworks of cross-fiber seams and veinlets in light green massive serpentine. The fibers are usually less than a quarter of an inch in length. Associated with the serpentine in the Bear Mountain zone are occurrences of talc. The formation of talc is from hydrothermal alteration of ultramafic rocks and serpentine. Although there are no producing talc deposits in the Bear Mountain zone, the potential for undiscovered talc and asbestos is recognized.

Melones Fault Zone, MRZ-3a$^{(i-2)}$: Bodies of both carbonate rock and ultramafic rock exist within the Melones fault zone. The ultramafic rock has been altered to serpentine, which contains chrysotile asbestos in the serpentine. The Nuner prospect, located a mile northwest of San Andreas, is reported to contain asbestos in serpentine (Clark and Lydon, 1962). Small amounts of talc occur at numerous locations in the serpentine bodies contained with the Melones fault zone. It is assumed that the potential for undiscovered deposits of asbestos and talc does exist within the serpentine bodies in the Melones fault zone. Also within the Melones fault zone are small high-grade limestone bodies that are similar to limestone of the Kentucky House deposit (MRZ-2b$^{(i-1)}$ (Fuller, personal communication, 1984). These limestone bodies are assumed to have potential for undiscovered resources of limestone.

Calaveras Complex Zone, MRZ-3a$^{(i-3)}$: Within the Calaveras formation are several shear zones that contain numerous bodies of talc-bearing schist. These zones extend into the adjoining Mokelumne Hill quadrangle to the north and the Columbia quadrangle to the east (figure 5).

The talc-bearing schist bodies contain talc and serpentine with no known asbestos and have a different character than the talc-bearing serpentine in the Melones fault and the Bear Mountain zones to the west. These scattered bodies of talc-schist are similar to the Red Hill talc body which is presently producing industrial grade talc (Western Source, Inc.) Thus these bodies are assumed to have the potential for undiscovered resources of talc because of their similarity and proximity to other producing bodies.

Silica Zone , MRZ-3a$^{(i-4)}$: Encompasses a series of thick quartz veins, some of which have produced industrial quartz in the past.

Many of the quartz veins in the Mother Lode are too limited in extent and contain too many impurities to be suitable as sources of silica. However, at Carson Hill, in 1924 the Iron Rock mine produced quartz from one of the massive quartz veins. Additional massive veins of white "bull quartz" tens of feet thick and hundreds to several thousand feet in length exist at Chaparral Hill and at the Norma Mine which may be suitable for industrial use.

Carbonate Rock Bodies, Calaveras Complex, MRZ-3a$^{(i-5)}$: Some carbonate rock bodies within the Calaveras Complex area have been classified MRZ-3a$^{(i-5)}$ because of their similarities to carbonate bodies that have been mined in the past. Most of the deposits are dolomitic or interbedded limestone and dolomite of small or moderate areal extent.

AREAS CLASSIFIED FOR DEPOSITS FORMED BY MAGMATIC CONCENTRATION (CHROMITE)

Primary deposits of chromite are formed as accumulations from magmatic segregations processes. They occur as disseminations and segregations in layered and Alpine-type ultramafic rocks. Ultramafic rocks which host deposits of chromite in the Sierra Nevada metamorphic belt are of the Alpine-type. Generally, economic concentrations of chromite of this type exist as podiform deposits, enveloped by dunitic masses. Although details on how the chromite is concentrated in these deposits are not well understood, it is generally accepted that ophiolitic terranes in which the deposits occur represent oceanic crust and upper mantle rocks generated at an ocean floor spreading center and that these rocks and enclosed chromite bodies formed from the same silicate melt. In nondisrupted ophiolitic complexes, most of the chromite pods are located between 1 or 2 km beneath layered gabbros (Thayer, 1960) and, in general, are randomly distributed in the residual mantle periodotites that include harzburgites and dunites (Lago and others, 1982). However, these relationships are normally obscured in Alpine-type ultramafic rocks because they have been dislocated or disturbed by folding, faulting, or serpentinization.

Previous studies of chromite occurrences in the ultramafic rocks of the Sierra Nevada include the works of Wells and others (1940), Cater (1948), Rynearson (1948), Cater and others (1951), Rice (1957), and Stanton (1972). Detailed mine descriptions and past production figures for some chromite mines in the area may be found in a

study conducted by Cater (1948), to which the reader is referred.

Although chromite has been recognized in Calaveras County since the 1850's it was probably first mined after 1890 and used for lining furnaces in copper smelters. According to local residents, most of the chromite produced in the study area was used for this purpose at the copper smelter at Copperopolis (Cater, 1948). The greatest amount of recorded chromite produced locally occurred between 1916 and 1918 when mines produced at least 1,700 long tons of ore. Chromite production ceased after 1918 with the exception of a slight resurgence during World War II, when 76 long tons of ore were produced (Cater, 1948).

Chromite in the study area has been mined from serpentinite bodies occurring in the western and central terranes. The greatest concentration of mines and prospects are located along the Bear Mountain fault zone and on the northwest flank of Soapstone Hill (Figure 3). The deposits typically occur in northwest trending, fault-bounded slivers of highly sheared serpentinite as fine to coarse disseminated and podiform masses. Minor amounts of white to light-green veinlets of chrysotile asbestos commonly are associated with the chromite. Trace amounts of kammererite were observed at one locale (mine location 10) and probably occurs in some of the other chromite deposits elsewhere. Chromite in the study area is reported to be low in chromic oxide and high in iron content (Cater, 1948, p. 40).

Mineral-land classification of the San Andreas quadrangle with respect to magmatic deposits is presented on Plate 5. The superscript "m" is used to denote areas classified for deposits formed by magmatic concentration (e.g. MRZ-3a$^{(m)}$. See **Mineral Resource Zone Categories** section, Part I, for explanation. For purposes of discussion, individual areas are assigned reference superscript numbers (e.g. MRZ-3a$^{(m\text{-}1)}$).

Areas Classified MRZ-3a$^{(m)}$

These are areas underlain by rocks within which undiscovered deposits formed by magmatic concentration, similar to known deposits in the same producing district or region, may reasonably be expected to exist (hypothetical resources). Within the San Andreas quadrangle, these are ultramafic rock belts that do or could contain segregations or disseminations of chromite.

Bear Mountains Serpentinite Belt, MRZ-3a$^{(m\text{-}1)}$: Chromite deposits within the San Andreas quadrangle occur in ultramafic rock marking the trace of the Bear Mountain fault zone (Plate l); here, fifteen of these deposits have been mined or prospected in past years. Within the Black Creek Area, which includes the Davis, Burnham, Walker, Clacy and Langford and Hinch mines, have a combined production of about 2,000 tons (Cater, 1948). An additional 1,000 tons was produced from the Vogelgesang and Ellingwood mines which lie northwestward along the same zone. All of the deposits occur within or very close to highly sheared serpentine bodies (Cater, 1948). Most of the deposits have been worked out. However, little if any exploration drilling to discover new or related deposits has been carried out since the 1940's.

Areas Classified MRZ-3b$^{(m)}$

These are areas that may contain undiscovered chromite resources that may occur either in known types of deposits in favorable geologic settings where discoveries have not been made, or in types of deposits unrecognized for their economic potential (speculative resources).

Melones Fault Zone, MRZ-3b$^{(m\text{-}1)}$: The association of chromite deposits to the Bear Mountain Fault Zone and the occurrence of small, isolated deposits of chromite elsewhere along the Melones Fault Zone that are associated with serpentinite masses the area within the Melones Fault Zone has been classified MRZ-3b for speculative resources of chromite.

Calaveras Complex, MRZ-3b$^{(m\text{-}2)}$: Occurring within the eastern half of the San Andreas quadrangle are small, disjointed lenticular serpentine masses within the Calaveras Complex. Although several of these small serpentine masses exist, only one has had any chromite production. The Madrid Mine, occurring within a sheared, schistose, altered serpentine, recorded 1,039 tons of production, and reserves are said to exist (Cater, 1948). Because of the overall lack of serpentine within the Calaveras Complex, the area has been classified MRZ-3b for speculative resources of chromite.

AREAS CLASSIFIED FOR PLACER GOLD DEPOSITS

Placer deposits are concentrations of heavy minerals that are localized by the energy of wave or current action of water or air. Economic deposits include gold, platinum-group elements, chromite, scheelite, cassiterite, ilmenite, rutile, zircon, niobium-bearing minerals, and diamonds. Gold placer deposits are the only ones of economic significance known to be present in the study area.

Placer mining has accounted for approximately 20 percent of the known gold production in Calaveras County since 1896 and probably was responsible for a high percentage of gold production prior to that time (Clark and Lydon, 1962). Julihn and Horton (1938) have estimated that at least $75,000,000 of placer gold (at a gold price of $20.67 per ounce) had been produced from within the county prior to 1896. Production from 1896 to 1936 amounted to $9,100,000 (gold price $20.67 to $35.00 per ounce), and from 1936 to 1956 an additional $7,600,000 was realized.

According to Clark and Lydon (1962), the first significant placer gold in Calaveras County was recovered in 1848 from the Mokelumne and Stanislaus Rivers and their tributaries. Placer mining of surface gravels thereafter quickly spread throughout the area with centers of activity located at Angels Camp, San Andreas, Vallecito, and centers of less importance at Calaveritas, Dogtown, and Mountain Ranch. Surface placer mining was quickly replaced in the larger centers by more sophisticated recovery techniques. In Angels Camp it was supplanted by lode gold mining by 1853 and, in Vallecito, surface placer mining was replaced by production from auriferous Tertiary channel deposits during the early 1850's. In San Andreas, surface placer operations were replaced in 1855

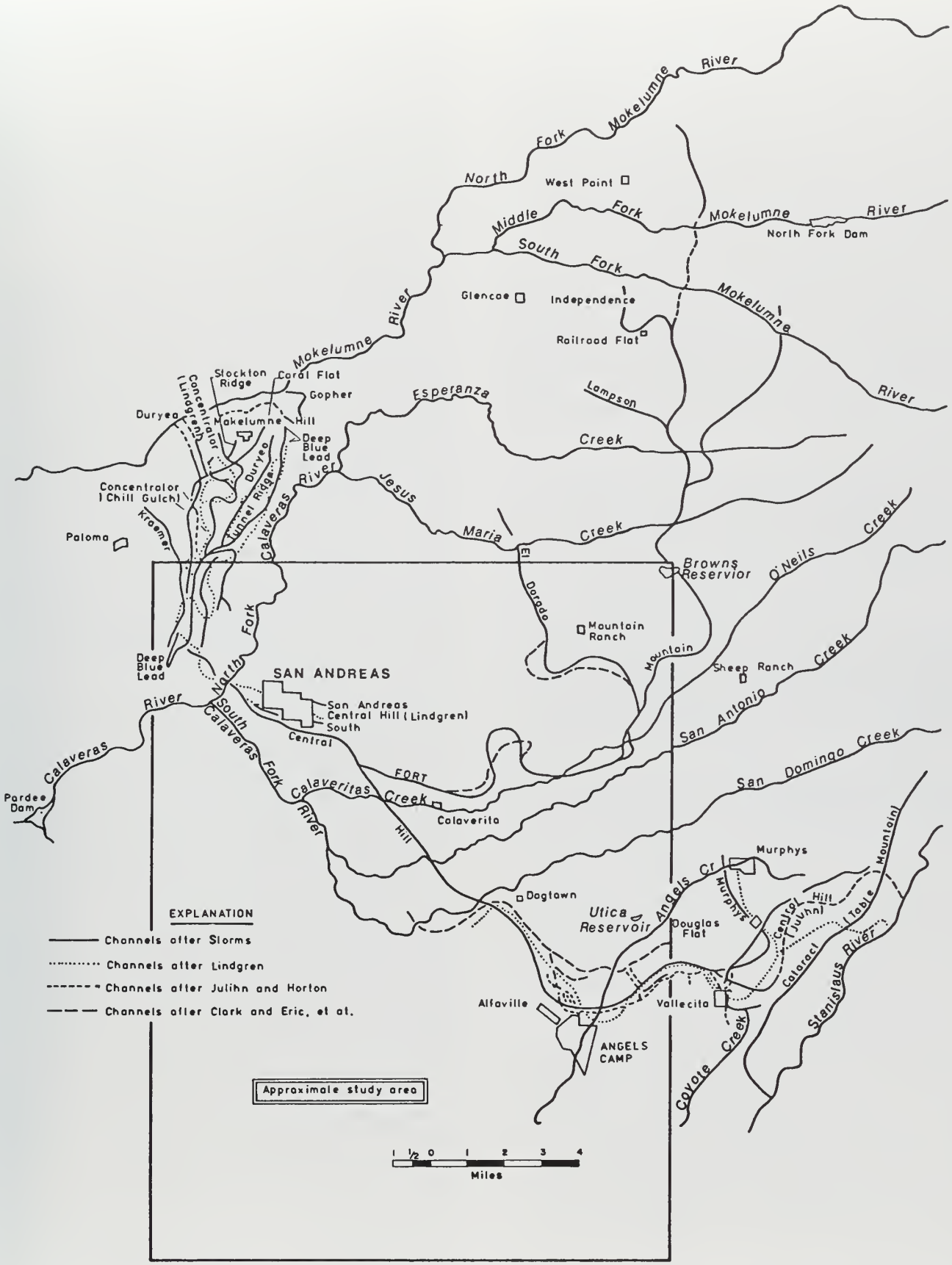

Figure 11. Map showing Tertiary Channels and auriferous gravel deposits in calaveras county (Clark and Lyndon, 1962).

by drift mining of Tertiary gravels located near Douglas Hill. By 1859, more than 80 drift mines were producing from the immediate vicinity of San Andreas and as a consequence drift mining became the dominant method of placer production within the area. Mining by hydraulic methods was also employed in Calaveras County from 1854 to 1905, and primarily confined to the San Andreas and Vallecito areas. Placer mining was curtailed by War Production Board Order L-208 in October, 1942, and thereafter only minimal production has been realized. Currently there is a revived interest in drift mining within the study area.

Mineral-land classification of the San Andreas quadrangle with respect to placer deposits is presented on Plate 6. Mineral resource zones assigned for placer deposits are denoted by the superscript "p" (e.g. MRZ-2a$^{(p)}$). See **Mineral Resource Zone Categories** section, Part I, for explanation. For purposes of discussion, individual areas classified are assigned reference superscript numbers (e.g. MRZ-3a$^{(p-2)}$) .

Areas Classified MRZ-3a$^{(p)}$

These are areas underlain by alluvial deposits within which undiscovered placer mineral deposits similar to known placer deposits in the same producing district or region may be reasonably expected to exist (hypothetical resources). In the San Andreas quadrangle, areas underlain by Tertiary age gravels of branches of the ancient Calaveras River, and the Valley Springs and Mehrten Formations which may contain auriferous gravels, have been labeled as MRZ-3a$^{(p-1)}$. Major streams have been labeled MRZ-3a$^{(p-2)}$, as they may be expected to contain gold derived from either local gold-bearing lode deposits or weathering of gold-bearing Tertiary gravel deposits.

Auriferous Gravels of the Ancient Calaveras River, MRZ-3a$^{(p-1)}$: Alluvial gold has been mined in the study area from; Eocene stream gravels, as well as gravels occurring in the Valley Springs and Mehrten Formations, from Recent stream deposits, and locally from alluvial deposits. The Tertiary stream gravel sources of gold has been discussed in general by Clark and Lydon (1962) and in detail by Storms (1894), Lindgren (1911), and Julihn and Horton (1938). As briefly explained by Clark and Lydon (1962), the auriferous Eocene gravels were derived from Late Cretaceous - Eocene rivers which formed the ancestral Calaveras River. This river system, known as the Central Hill Channel, followed a westward course through Vallecito and Central Hill area. It is joined approximately 2 miles northeast of Calaveritas by the Fort Mountain Channel which, together with the El Dorado Channel, drains the Mountain Ranch area. A larger and richer channel system (according to Lindgren, 1911) drains the Mokelumne Hill area to the north and junctures with the Central Hill Channel, northwest of San Andreas. The complex system of tributary channels in the Central Hill area includes the Chili Gulch, Concentrator, Deep Blue Lead, Duryea, and Kraemer channels (See Figure 11).

The Eocene river channels are overlain by the Oligocene(?)-Miocene age Valley Springs Formation, which primarily consists of rhyolitic pebble-bearing alluvium and interbedded rhyolitic tuff up to 400 feet deep near Mountain Ranch (Turner, 1894). The Valley Springs covering was extensive and resulted in the formation of a complex system of superimposed and cross-cutting channels which have pirated gold from an earlier source which ultimately is attributable to the Eocene auriferous gravels. Tectonic uplift of the Sierra Nevada was accompanied by an extensive covering of Miocene-Pliocene age andesitic flows, tuff, and mudflows that now represent the Mehrten Formation.

By 1898, at least 100 miles of Tertiary stream courses (Eocene channels) had been identified within Calaveras County (Storms, 1898). Approximately 25 percent of this had been removed through subsequent erosion by recent streams and approximately 25 percent had been mined, suggesting that approximately 50 miles of Tertiary stream channels remained undisturbed as of that year. Similar to the formation of other placers, the Tertiary gravel deposits tended to concentrate gold along lower velocity channel margins, within a few inches of the alluvium-bedrock surface, and above clay streaks within the channel deposits (Aubury, 1910). The configuration, size and grade of alluvial gold deposits varies between channels, and along reaches of any one channel, as noted by Lindgren (1911). In the Vallecito area, the Central Hill deposits range from 10 to 20 feet wide in areas with steep gradients, to 100 feet wide at Vallecito Flat and up to 1,000 feet wide just above the town of Vallecito (Storms, 1898, p. 484). The individual channels are described in detail by Lindgren (1911).

Most of the Tertiary placer deposits in the study area were developed by drift mining or, where possible, by hydraulic mining. The cemented gravels were broken down by stamp mills or trommels and then concentrated through gravity methods using sluices, jigs, and tables (Clark and Lydon, 1962). Local concentrations of gold cited by Lindgren (1911) for the Central Hill Channel include $5 per ton at the Monarch pit and $2 to $10 per ton (gold price at $20.67 per ounce) at the Jackrabbit mine (locality 244) from a deposit which was 35 feet wide, 7 feet high and 75 feet long. One of the better recorded placer mines in the study area was the Calaveras Central mine, on the Central Hill Channel. It produced fine to coarse gold from cemented gravels extracted from channels up to 250 feet wide, and yielded an average of $4.74 per ton during the period from 1931 to 1937 (Clark and Lydon, 1962). During 1934 the Lloyd Mine in the Central Hill area (locality 249) produced 802 ounces of "pinhead to wheat grain" gold and 124 ounces of silver from 12,000 tons of gravel. In the same report Clark and Lydon (1962) report that the Rising Star mine (locality 256), also situated in the Central Hill area, was mining gravel which contained $4 per ton in gold.

Modern River and Stream Beds, MRZ-3a$^{(p-2)}$: Placer gold continues to be mined on a small scale from river and stream beds in the Sierra Nevada foothill region. Most of the gold presently being mined is recovered by suction dredging and as a byproduct of in- or near-stream aggregate operations. All major river and creeks in the project area which drain areas containing either lode gold depos-

its or auriferous Tertiary channel deposits have been classified MRZ-3a for placer gold resources (Plate 6).

SUMMARY

Evaluation of the San Andreas quadrangle indicates that five genetic classes of mineral deposits are judged to be present, or likely to be present, in sufficient concentrations to be of economic significance. There are: (1) deposits formed by hydrothermal processes (gold and associated metals); (2) deposits formed by volcanogenic processes (copper, zinc and associated metals); (3) industrial minerals formed by diverse processes (talc, silica, and carbonate rock); (4) deposits formed by magmatic concentration (chromite); and (5) placer deposits (gold).

- Precious and base metal deposits formed through hydrothermal processes occur along the traces of several northerly trending, talc-bearing fault and shear zones extending through parts of the study area. These quartz vein-hosted deposits have yielded substantial amounts of gold in past years and comprise, in part, what historically is known as the "Mother Lode Gold Belt." The gold typically occurs in native form, along with base metal sulfides in small but often rich pockets.
- Copper-zinc and associated base and precious metal mineralization occurs within the northwest trending marine volcanic rock sequences of the Gopher Ridge and Copper Hill Volcanics. Two massive sulfide deposits are known to exist within the quadrangle and additional deposits are likely to exist.
- Carbonate rock is present in small (less than several hundred feet long) to relatively large (more than 2000 feet long) isolated, lensoidal masses consisting of varying amounts of limestone, dolomite, and marble. One carbonate body, the Kentucky House deposit, has been in almost continuous operation since 1926 for cement production. Sampling and drilling at other localities demonstrate significant carbonate rock resources suitable for a number of industrial uses including cement, filler, and glass manufacturing.
- Talc bodies are exposed along several structural zones in the area. In some cases the talc is an alteration product of mafic and ultramafic igneous rocks while in other cases it is a possible alteration product of dolomite and metamorphic quartz mica schist. Western Source Inc., currently produces a high quality talc from their Red Hill mine.
- Chromite in the study area has been mined from serpentinite bodies occurring in the western and central terranes. Typically occurring in northwest trending, fault-bounded slivers of highly sheared serpentinite as fine to coarse disseminated and podiform masses, the deposits have had little, if any, production since the 1940's.
- Placer gold exists in remnants of ancient river channel deposits exposed in several localities in the study area, as well as in modern river and stream beds.

Although both types of placers have been worked extensively since the gold rush days, modern mining techniques (or as yet undeveloped technology) and economic conditions could make mining these deposits economically feasible at the present time or within the forseeable future.

RECOMMENDATIONS

Portions of the study area have been classified as containing mineral deposits of economic or potentially economic significance (MRZ-2a and MRZ-2b). Other areas have been recognized as including terranes which provide favorable geologic environments for the presence of significant mineral deposits (MRZ-3a and MRZ-3b). Lead agencies should consider the contribution that these mineral resource areas could make to the economy and well-being of the region and state, and then weigh these considerations against other competitive land-use demands which may preclude access and utilization of the mineral resources.

Further investigations are desirable in areas classified MRZ-4 in order to better define their mineral potential. Any information gained by the mining industry and made available would be of considerable value to the mineral land classification effort and could materially improve upon the knowledge of the mineral value of the area.

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APPENDIX A

MINES AND PROSPECT DESCRIPTIONS

APPENDIX A - MINES AND PROSPECTS OF THE SAN ANDREAS QUADRANGLE

MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
1	Alta	T2N R12E Sec 14 SW 1/4 Sec 23 NE 1/2	Chromite	A number of small discontinuous chromite lenses, pods, and small layers of disseminated chromite are present in a wide northwest-striking belt of serpentine, along with dunite and small amounts of impure tremolite asbestos. The serpentine is highly sheared in places and ranges from dark green to black in color. The mineralization is N45°W to N55°W strike and dip steeply to the northeast. Present work is confined to the northwest portion of tha property where there is a 45 ft. vertical shaft and a 35 ft. northwest drift at the bottom of the shaft. There is a lens of chromite 3 ft. long and a few inches thick exposed in the drift. There is an open cut 1,500 ft. to the southeast and another 300 ft. to the northeast. Approximately 2,200 ft. southeast of the shaft are old workings mined years ago, consisting of open cuts and a caved crosscut adit. Production unknown.	Clark and Lydon, 1962, p. 21
2	Burnham	T2N R12E Sec 23 NE 1/4	Chromita	Active in 1915 with 65 tons of ora being produced from a 40 ft. shaft, last active in 1927.	Logan, 1936, p. 244; Cater, 1948, p. 46; Clark and Lydon, 1962, p. 128
3	Clary and Langford	T2N R12E Sec 10 NW 1/4	Chromite	The mine was first operated some years prior to the first World War and 100 tons of ore is said to have been used by a local copper smelter as furnace linings. In 1916-1917 the mina was leased by H. Clary and George Langford who produced 223 long tons of chromite containing 45 to 46 percent of chromic oxide. J.E. Porter and J.H. Spring acquired the property in 1918, and produced an additional 125 long tons of ore; thus, the total recorded production is 348 long tons. The main workings east of the road consist of a flooded open-cut, and two flooded shafts, each said to be 45 or 50 ft. deep. The ore was in highly sheared serpentine. No ore can be seen in place but a few fragments of medium-to coarse-grained massive chromite containing minor quantities of kammererite are scattered about the dumps. Taliaferro states that about 60 tons of ore is said to have bee mined from a lens over which the road passed. Tha road was shifted, the ore mined, and then the road was restored to its original position. A shaft and a few small cuts were reported by Taliaferro in a small detached mass of serpentine half a mile to the west. Reserves in all the workings are probably negligible.	Bradley, 1918, p. 121; Logan, 1925, p. 165; Cater, 1948, p. 47
4	Davis	T2N R12E Sec 23 SE 1/4	Chromite	Last worked in 1918. Two groups of shallow underground workings and irregular open cuts. The open cuts on the south deposit trend about N30°W and probably indicate the trend of the ore. All of tha workings are in sheared serpentine. About 225 long tons of ora produced.	Bradley, 1918, p. 121; Logan, 1925, p. 165; Cater, 1948, p. 46
5	Hinch	T2N R12E Sec 3 SW 1/4 .	Chromite	Active in 1905 when 15 tons of chromite was produced for furnace linings in a nearby copper smelter. During World War I an additional 300 tons of ore was produced from three open-cuts and a shaft. The deposit consisted of a number of irregular, northwesterly trending pods and lenses of medium-grained almost massive chromite.	Bradley, 1918, p. 121; Logan, 1925, p. 165; Logan, 1936, p. 233; Cater, 1948, p. 47

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
6	Stone (Coffer, Trask)	T2N R12E Sec 23 SW 1/4, 24	Chromite	Last active during World War I, the deposit was worked from five shafts, three of which were flooded when visited by Cater in 1945. Taliaferro states that the main shaft is 40 ft. deep and that two drifts were driven from the bottom of it along a lens of ore about 3 ft. wide and striking N25°W. The country rock is sheared, talcose serpentine and specimens of ore from the dump are of massive, medium-to coarse-grained chromite. A somewhat irregular shaft said to have been 35 ft. deep is about 250 ft. N20°W of the main shaft. Scattered pieces of ore on the dump are similar to those found at the main shaft. A 15 ft. shaft nearby is in a small lens of banded, disseminated ore about 40 ft. west of the serpentine contact. This ore body strikes N55°E and is traceable for about 15 ft. The banding dips vertically and lies parallel to the trend of the ore zone. Layers of high-grade disseminated chromite 1/4 to 1 inch thick alternate with barren serpentine forming an ore containing an average of 60 percent chromite. Probably very little, if any, chromite was mined from a 30 ft. shaft about 500 ft. S15°E of the main shaft, for no ore was seen on the dump. The fifth shaft, about 35 ft. deep, lies across the gulch about 500 ft. west of the main shaft. Ore from this shaft is very coarse-grained massive chromite without visible interstitial gangue. All the ore bodies are near the east contact of the serpentine. The mine has a recorded production of 92 long tons of ore, most of which came from the main shaft. Though some ore is said to remain in the bottom of the high-grade workings, reserves are probably small.	Cater, 1948, p. 46
7	Voselsang	T4N R11E Sec 34 SW 1/4.	Chromite	The mine has been inactive since World War I when 229 long tons of ore containing 43 to 46 percent of CR_2O_3 was produced from a series of open cuts. The deposit consists of a group of pods and lenses of massive chromite traceable for 230 ft. along a shear zone striking N35°W and dipping 75°NE. This zone lies parallel to and 10 to 30 ft. east of the western contact of the serpentine, which in this area is not over 1,000 ft. wide. A few scattered pits continue along the same strike for an additional 300 ft., but very little chromite has been taken from any of them. Most of the country rock is slickentite but near the contact with the older metamorphic rocks much pyroxenite is found. A pegmatite dike composed of large crystals of plagioclase, pyroxene, and muscovite is intruded along the same shear from which the largest single lens of chromite was mined. The ore is massive, medium-grained chromite, having a black color and a submetallic luster. The largest single lens was about 50 ft. long, had a maximum thickness of 4 to 5 ft., and was mined to a depth of 30 ft.	Bradley, 1918, p. 123; Logan, 1925, p. 165; Cater, 1948, p. 48

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
8	Walker (Bushy Hill Chaparral)	T2N R12E Sec 15 E 1/2	Chromite	This chromite mine was worked originally during World War I by F.G. Walker and C.A. Gillis. A total of 71 long tons of ore containing approximately 40 percent chromic oxide was produced (Cater, 1948, p. 42). It was prospected in 1940 by B.W. Cresswell, but apparently has been idle since. A small amount of asbestos and chrome prospecting has been done recently west of the mine. The deposit is near the east margin of a serpentine body. The ore body consists of a 2 ft. thick lens of chromite with associated disseminated chromite in highly sheared light-green serpentine. Granodiorite lies to the east, and in the vicinity of the deposit there are diorite dikes and some dunite. To the west of the deposit the serpentine contains some asbestos. The mine is developed by a main 60 ft. shaft now caved, and two other shallower shafts, 200 and 2,000 ft. to the southeast.	Bradley, 1918,p. 123; Cater, 1948, p. 47; Clark and Lydon, 1962, p. 22
9	Unknown	T2N R12E Sec 17 SW 1/4			
10	Unknown	T3N R13E Sec 2 SW 1/4			
11	Valenti	T3N R13E Sec 2 SW 1/4	Chromite	Deposit was located during the 1930's and 1940's with only a minor amount of trenching done on the property. Deposit consists of a lens of nearly massive chromite, 1 to 4 ft. thick, striking N60°E. The country rock is sheared serpentine, and contacts of the chromite and serpentine are sheared and slickensided. The ore is medium-grained, nearly massive chromite, but assays only 28 percent CR_2O_3.	Cater, 1948, p. 57
12	Bund	T3N R12E Sec 12 W 1/2	Copper	Developed prior to 1916 with three shafts of 50, 75 and 108 ft. depth on vein occurring on contact of amphibolite and serpentine.	Tucker, 1916, p. 56; Eric, 1948, p. 218; Clark, 1954, p. 21
13	Clothier and Cameron	T2N R12E Sec 2	Copper	An 18 inch vein of pyrite with chalcopyrite in greenstone. Prospected early 1900's with a 35 ft. shaft.	Aubury, 1908, p. 245; Eric, 1948, p. 219

APPENDIX A - MINES AND PROSPECTS OF THE SAN ANDREAS QUADRANGLE

MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
14	Nassau (Pool)	T2N R10E Sec 9 NE 1/4	Copper	The Nassau copper mine, consisting of the Goat Ranch and Goat Ranch Extension claims, was worked by A.S. Pool prior to 1900. This property was acquired by the Nassau Copper Company in the early 1900's, and by 1908 the company had sunk a 300 ft. shaft and reportedly had mined $70,000 worth of copper ore (Aubury, 1908, p. 245). The mine was operated intermittently through 1919. There is no record of further activity until 1941, when the shaft was dewatered (Eric, 1948, p. 221). No production resulting from this operation is known. Ore bodies in this mine are parallel high-grade lenses ranging from a few inches to 2 ft. in thickness in a narrow body of metadiabase. The footwall is slate, and the hanging wall is diorite. Unoxidized ore, found within 30 ft. of the surface, consists of chalcopyrite associated with pyrite, minor amounts of gold and silver, and as much as 18 percent zinc, as sphalerite. Shipping ore contained an average of about 0.2 ounces gold, 4.6 ounces silver, 5.2 percent copper, and 17.9 percent zinc (Tucker, 1916, p. 58). Precipitating tanks were used to produce copper cement from the mine water. Mine workings consist of a 430 ft. vertical shaft with levels at 95 and 200 ft. Drifts extend north 200 and 240 ft., and south 800 and 820 ft., on the upper and lower levels respectively. The shaft is open, but no equipment remains on the property.	Aubury, 1905, p. 198; Aubury, 1908, p. 245; Forstner, 1908, p. 744; Tucker, 1915, p. 58; Weed, 1916, p. 805; Eric, 1948, p. 221; Clark and Logan 1962, p. 28
15	McCarty Ranch Copper Mine	T2N R12E Sec 18 NE 1/4			
16	Able	T3N R12E Sec 20 SW 1/4	Lode Gold	Vein in greenstone strikes NW and dips NE. Long idle and developed by a shaft.	Clark and Logan, 1962, p. 134
17	Adelia	T2N R13E Sec 5 NE 1/4	Lode Gold	Long idle. Developed by shaft. Vein with greenstone on hanging wall and phyllite on footwall strikes N45°W and dips 75°NE.	Eric, Stromquist, and Swinney 1955, Plate 1; Clark and Logan, 1962, p. 134
18	Alameda	T4N R13E Sec 23 NE 1/4	Lode Gold	Active around 1896. Developed by 115 ft. drift adit. A 1 to 4 ft. quartz vein in black slate strikes NW and dips NE.	Crawford, 1896, p. 96; Clark and Logan, 1962, p. 134
19	Albany	T4N R13E Sec 28	Lode Gold	Long idle. Developed by 500 ft. adit. A 1 1/2 ft. vein in slate and mica schist strikes W and dips N.	Kerr, 1900; Clark and Logan, 1962, p. 134
20	Alcoyne	T3N R13E Sec 17 NE 1/4	Lode Gold		
21	Alpine (Blue Eagle)	T4N R13E Sec 20 E 1/2 Sec 21 W 1/2	Lode Gold	Active 1896-1901. Developed by 90 and 150 ft. drift adits. A 2 to 7 ft. vein containing pyrite, galena, and sphalerite, strikes N68°W and dips 80°NE. Slate on hanging wall, mica schist on footwall. Ore yielded as much as $125 per ton.	Clark and Logan, 1962, p. 135
22	Actaville	T3N R13E Sec 28 SW 1/4	Lode Gold	Active 1860's and 1890's. Developed by 400 ft. shaft with ore treated in 8 stamp mill. Quartz vein in green schist strikes NW and dips 75°NE.	Clark and Logan, 1966, p. 135

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
23	Ambrosia	T4N R12E Sec 28 SW 1/4	Lode Gold	Long idle. Developed by shaft. Vein in schist and slate strikes NW and dips NE.	Logan, 1936, p. 292
24	Angels Group	T3N R13E Sec 28 SE 1/4	Lode Gold	Originally worked in the 1850's and in 1872 developed by a 600 ft. shaft. In 1886, the claims were consolidated by the Angels Quartz Mining Company and worked as a unit almost continuously until March 1918. A $100,000 pocket was reported to have been discovered on the Crystal claim in 1910 (Mining and Scientific Press, 4/9/10, p. 537). The total output of the property is unknown, but published figures show its value exceeds $3,250,000. A number of quartz veins are in the property, but the bulk of the production was from two known as the Mother Lode and the East vein (Logan, 1935, p. 127). Some output was made from a rich narrow vein lying to the east of the main vein and from a vein to the west on the Crystal claim. All of the veins strike northwestward and dip steeply to the northeast. Country rock in the general area of the mine is green schist; gabbro lies to the west (Eric and Stromquist, 1955, Plate I). The productive veins in the main ore zone had an average thickness of 20 ft.; the footwall was diorite, the hanging wall a heavy talcose slate (Tucker, 1916, p. 69). Stope lengths ranged from 100 to 200 ft. The value of ore mined during the last years of operation ranged from $2 to $10 per ton and the concentrates ranged from $38 to $70 per ton in gold at the old price of $20 per ounce. The principal working entry was the 850 ft. Angels shaft. From the 850 ft. level a winze was sunk to the 1,050 ft. level, and an 800 ft. crosscut was driven east. The 600 ft. Crystal shaft is located to the southwest. During the last operations, ore was mined on the 200-400, and 500 ft. levels. The mill, which treated about 200 tons of ore per day, was equipped with 40 stamps and 16 Frue vanners.	Clark and Logan, 162, p. 40, 135
25	Angels Deep Group	T3N R13E Sec 33 NW 1/4.	Lode Gold	Originally worked at shallow depths during the early days of the Gold Rush and by a 187 ft. shaft in 1896. Shaft was extended to 500 ft. in 1920 and a 20 stamp mill constructed. A series of northwest-striking and northeast-dipping quartz veins and mineralized schist containing free gold and sulfides, including pyrite and arsenopyrite, constitute the ore body. Country rock consists of amphibolite and chlorite schist. Ore averaging $9 to $11 per ton in value was encountered during the 1930's (Logan and Frank, 1936, p. 240). The mine is developed by the 500 ft. inclined Pioneer shaft with levels at 50, 135, and 423 ft., and the southern 140 ft. vertical Smyth shaft with levels at 84 and 130 ft. Several thousand ft. of drifts have been run. The last work done on the property was in the Smyth workings.	Clark and Logan, 1962, p. 41, 135
26	Annie	T2N R13E Sec 20 SW 1/4	Lode Gold	Active in early 1900's, Prospected and developed by shallow shaft in 1920's. A 2 to 4 ft. vein in greenstone strikes NW and dips NE.	Clark and Logan, 1962, p. 137
27	Apex	T2N R13E Sec 11 SW 1/4	Lode Gold		

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
28	Bachman	T3N R12E Sec 11 W 1/2	Lode Gold	Active sometime between 1894 and 1914, and intermittently in 1920's and 1930's; small production developed by 478, 305 and 70 ft. shafts. Several gold quartz veins in phyllite and slate strike NW and dip NE; one vein as much as 30 ft. thick.	Clark and Logan, 1962, p. 137
29	Basco	T4N R13E Sec 33 N 1/2	Lode Gold	Long idle. Developed by open 200 ft. N crosscut adit and connecting 100 ft. shaft. Vein in graphic schist and slate strikes W and dips 55°N.	Clark and Logan, 1962, p. 137
30	Bear Mountain	T3N R12E Sec 33 NW 1/4	Lode Gold	Active 1932-1933, 1940. Developed by shallow shaft. Vein in greenstone strikes NW and dips NE.	Clark and Logan, 1962, p. 137
31	Belle	T2N R13E Sec 23 E 1/2	Lode Gold	Active early 1890's. Developed by 300 ft. crosscut adit and drifts. Three veins 4 to 55 ft. wide, strike NW and dip NE; diorite hanging wall, slate footwall; free milling ore with abundant sulfides.	Clark and Logan, 1962, p. 137
32	B e n c e Tellurium	T4N R13E Sec 34 E 1/2	Lode Gold	Originally worked in the 1860's and intermittently to 1938. Production several hundred thousand dollars. This mine is on the east end of a major vein system which includes the Bonehard, K and J, and Esmeralda gold mines (See Clark, 1954, Plates 1 and 2). The vein ranges from 2 to 6 ft. in thickness, strikes in a westerly direction, and dips 60 to 75 degrees to the north. As in the case of the other mines in the district, the ore contained free gold and often abundant amounts of sulfides. Ore mined in the 1930's was reported to have contained $10 per ton in free gold (Logan and Frank, 1936, p. 242). Some tellurides were recovered during the early period of operation. Country rock is graphitic slate and quartz-mica schist; green schist lies just to the south. The mine is developed by a 150 ft. north crosscut adit to the vein, from which a 400 ft. drift extends westward. Two shafts have been sunk to depths of 175 and 400 ft. The vein has been stoped to the surface adjacent to the shafts.	Clark and Logan, 1962, p. 41, 137
33	Ben Hur	T4N R13E Sec 7	Lode Gold	Long idle. Developed by 115 ft. adit. Two veins in slate strike NW and dip NE.	Clark and Logan, 1962, p. 137
34	Benson	T3N R13E Sec 30 S 1/2	Lode Gold	It was probably worked during the early days of the gold rush as were the other mines in the vicinity, when rich surface ores were recovered in quantity. Under the direction of John C. Benson, the mine was operated from the latter 1890's until 1909 and was reported to have had a large output (Logan and Frank, 1936, p. 247). The ore was treated in a 10 stamp mill. In 1936, this and the adjoining Parnell mine were prospected by the Cal-Gold Mining Company. A 20-ton mill was erected, but very little ore was mined, and the mine has been idle since. The vein strikes northwestward and dips to the northeast. The hanging wall is amphibolite schist and the footwall is slate and phyllite. The vein is developed by a 510 ft. inclined shaft with levels at 100, 200, 300, and 500 ft. The shaft is open. Most of the drifting has been done on the 100- and 200- ft. levels (Logan and Frank, 1936, p. 247).	Clark and Logan 1962, p. 42, 137

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
35	Bernasconi Mine	T3N R12E Sec 23 NW 1/4	Lode Gold		
36	Big Four	T3N R12E Sec 11 SW 1/4	Lode Gold	Long idle. Developed by 136 ft. shaft now caved, and open cut. Three veins in slate and phyllite strike NW and dip NE.	Clark and Logan, 1962, p. 137
37	Big Seven	T2N R12E Sec 22 SE 1/4 Sec 27 NE 1/4	Lode Gold	Active prior to and during 1936. Developed by a 110 ft. inclined shaft with levels at 50 and 100. A mineralized zone as much as 300 ft. wide strikes NW and dips NE, contains free gold with galena, pyrite and sphalerite.	Clark and Logan, 1962, p. 138
38	Big Spring	T2N R13E Sec 3 SE 1/4	Lode Gold	The Big Spring gold mine probably was originally worked during the gold rush, when considerable amounts of rich surface ores were mined in the general area. Little is known of subsequent operations. In 1914 the mine was idle, but was reported to have been developed to a depth of 100 ft. (Tucker, 1916, p. 70). C.E. Gruwell of Angels Camp reopened it in 1932 and operated it almost continuously until 1941. Except for the dump being occasionally used as a source of road fill, the mine has been idle since 1941. There are two veins on the property-the Mother Lode vein, and some 80 ft. to the west at the surface, the Back vein. Both veins strike northwestward and dip to the northeast. The Back vein has an average thickness of 5 ft. The ore contains free gold, pyrite, and considerable gouge. Ore mined in 1938 was reported to have averaged $10 per ton in value, but occasionally it was valued as high as $60 per ton (Julihn and Horton, 1938, p. 129). Country rock is amphibolite and chlorite schist. The mine is developed by a 230 ft. inclined shaft.	Clark and Logan, 1962, p. 42, 138
39	Bismark	T4N R12E Sec 29 SE 1/4	Lode Gold	Active around 1877 to 1884 and 1900. Developed by 550 ft. adit. A 2 to 4 ft. vein with slate hanging wall and schist footwall strikes N24°W and dips NE; ore yielded as much as $40 per ton.	Clark and Logan, 1962, p. 42, 138
40	Black Oak	T3N R13E Sec 19 SW 1/4	Lode Gold	Active 1882 and 1904; may have been prospected in 1930's. Developed by 220 ft. shaft, crosscut adit and open cuts. Quartz vein with stringers in green schist and phyllite strikes N45°W and dips NE.	Clark and Logan, 1962, p. 138
41	Blue Ribbon	T4N R13E Sec 3 E 1/2	Lode Gold	Long idle. Vein in mica schist and slate strikes north.	Clark and Logan, 1962, p. 139
42	Bolitha	T2N R13E Sec 3 E 1/2	Lode Gold	Active prior to and from 1894 to around 1900. Developed by 200 and 300 ft. shafts, two adits, and several thousand ft. of drifts and crosscuts. Mother Lode vein known as Dead Horse lead consists of gold and pyrite bearing amphibolite schist with quartz stringers, strikes NW and dips 60°NE; 30 to 40 ft. wide.	Clark and Logan, 1962, p. 140

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
43	Bonanza	T2N R12E Sec 14 SW 1/4	Lode Gold	Active in 1920's; prospected 1934. Developed by 95 ft. shaft with levels at 30, 50 and 85 ft. A 1 to 3 ft. wide vein containing free gold and sulfides strikes NE and dips SE; talcose footwall and slate hanging wall.	Clark and Logan, 1962, p. 140
44	Bonanza	T4N R13E Sec 18	Lode Gold	Active in 1898. Developed by 56 ft. shaft and 200 ft. adit. Two veins, up to 10 ft. thick in slate, strike NW and dip NE.	Clark and Logan, 1962, p. 140
45	Bonanza Pocket	T3N R13E Sec 11 NW 1/4	Lode Gold	Long idle. Developed by open cuts and shallow shaft. Vein in mica schist strikes W and dips N.	Clark and Logan, 1962, p. 140
46	Bonehard	T4N R13E Sec 33 NE 1/4	Lode Gold	Long idle. Developed by open 100 ft. crosscut adit. Vein in graphitic schist and slate, strikes WNW and dips N.	Clark and Logan, 1962, p. 140
47	Brazza (Bruzza)	T4N R13E Sec 34 S 1/2	Lode Gold	Active around 1896. Developed by 70 ft. shaft, 70 ft. drift and open cut. A 1 ft. vein in slate and graphitic schist strikes NW and dips NE; some rich pockets found.	Clark and Logan, 1962, p. 140
48	Brown (Defiance)	T2N R12E Sec 18	Lode Gold	Active 1935. Mined by open cut. Ore treated in 2 stamp mill. Vein in amphibolite, schist and slate. Ore yielded $8 per ton.	Logan, 1936, p. 246
49	Bruner	T2N R13E Sec 10 NE 1/4	Lode Gold	Active prior to 1888, latter 1890's, 1913-1914 and 1938-1940. The vein strikes northwestward, dips northeast and consists of a mixture of quartz stringers and country rock impregnated with free gold, auriferous sulfides and ankerite. Country rock is chloritic amphibolite schist. The mine is developed by a 400 ft. inclined shaft with levels at 100 and 400 ft.	Clark and Logan, 1962, p. 43, 140
50	Bullion (Mother Lode Central)	T2N R13E Sec 10 NE 1/4	Lode Gold	Active prior to the early 1900's, operations ceased in 1939. There are two veins on the property, the Marble Springs vein which strikes northwestward and dips 55°NE, and the Bullion vein to the southwest which strikes nearly westward and dips 55°N. The Marble Springs vein is as much as 15 ft. thick. An ore shoot was developed on this vein several hundred ft. southeast of the shaft, which had a stope length of 130 ft. and a pitch length of at lest 300 ft. It was reported to have contained ore averaging $7.50 per ton in gold (Julihn and Horton, 1938, p. 117). Country rock is green schist. The mine is developed by at least three shafts: No. 1 shaft on the Marble Spring claim, which has an inclined depth of 200 ft. and from which a 105 ft. crosscut extends to the vein on the 200 ft. level; No. 2 shaft some 500 ft. to the southeast and sunk on the vein, which has an inclined depth of about 600 ft.; and an old 150 ft. inclined shaft on the Bullion vein. A 500 ft. drift connects No. 1 and No. 2 shafts on the 200 ft. level. Other than several buildings, no equipment remains on the property.	Clark and Logan, 1962, p. 64, 169
51	Burgess	T3N R12E Sec 3 SW 1/4	Lode Gold	Active prior to and during 1880's when ore was treated in 20 stamp mill; output worth $18,000 up to 1889. Developed by shaft, a 5 ft. vein in slate and phyllite strikes N55°W, and dips 65°NE.	Clark and Logan, 1962, p. 141

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
52	Calaveras Mine	T2N R13E Sec 24 NE 1/4		See Carson Hill.	
53	California Ophir	T2N R13E Sec 14 E 1/2	Lode Gold	Idle since 1903. Developed by 600 ft. inclined shaft with levels at 200, 400, and 600 ft. A 5 ft. vein with greenstone footwall and slate hanging wall.	Clark and Logan, 1962, p. 142
54	Carson Creek	T2N R13E Sec 23 SW 1/4	Lode Gold	Discovered in 1862 and active until about 1914. Total production estimated at $1,000,000. Developed by a 700 ft. shaft. Two veins, 15 to 30 ft. in width, strikes NW and dips NE.	Clark and Logan, 1962, p. 44
55	Morgan (Carson Hill Group)	T2N R13E Sec 13, 14	Lode Gold	The Morgan mine was discovered in 1850 and was so rich that thousands were attracted to the camp. The largest single piece of quartz gold ($43,534, Hanks, 1882) ever reported was taken from this mine. It was 5 inch in diameter and 4 ft. to 5 ft. long, and was part of a $300,000 pocket. In less than 2 years from 1850 to 1851 the Morgan mine yielded $2.8 million with reportedly large amounts of gold being stolen by "high-graders". In 1919, Carson Hill Gold Mines discovered additional rich ore near the intersection of the ribbon vein, a stratified 6 ft. wide vein, and the bull-quartz vein, a 40 ft. wide relatively barren quartz vein. From 1919 to 1926 the mine produced $4.5 million (Logan, 1935, p. 129-133). The mineralization occurs in the schist host rock adjacent to the bull quartz vein. The ore consists of sericite schist composed largely of ankerite with pyrite, sericite, quartz, and albite along with some galena, chalcopyrite, tetrahedrite, marposite, petzite (gold telluride) and free gold. The ore zone is from 31 ft. to 41 ft. in thickness and 140 ft. to 350 ft. in length and dips 30°NE and is 10 ft. to 12 ft. thick and consists of quartz sericite, and pyrite with mariposite, ankerite, galena, chalcopyrite, and gold.	Hanks, 1882, p. 148; Logan, 1925, 147-150; Logan, 1935, p. 129-133; Logan, 1936, p. 247-248; Julihn, 1938, p. 100-110; Bowen, 1948, p. 55; Clark and Lydon, 1962, p. 60, 169
56	Chaparral and Blue Ribbon	T4N R13E Sec 28 SE 1/4	Lode Gold	Intermittently active 1919-1942; developed by 300 ft. N crosscut adit, glory hole, shaft and two 100 ft. adits. A 4 ft. quartz vein with free gold and abundant pyrite strikes W and dips N; mica schist and slate country rock.	Logan, 1936, p. 248-249; Clark and Logan, 1962, p. 143
57	Chaparral Hill	T2N R13E Sec 14 N 1/2	Lode Gold	Active 1881, 1914. Developed by shallow shafts and adits, one 500 ft. long. Massive quartz vein to 100 ft. in width, ore contained tellurides and arsenopyrite; amphibolite country rock.	Clark and Logan, 1962, p. 143
58	Cherokee	T3N R13E Sec 29 NW 1/4	Lode Gold	No description available.	
59	Cleveland	T4N R13E Sec 8	Lode Gold	Active prior to and during -1893. Developed by 100 ft. shaft. Ore treated in 5 stamp mill. Vein in mica schist.	Clark and Logan, 1962, p. 144
60	Clincher	T4N R13E Sec 21	Lode Gold	Long idle. Developed by 60 ft. shaft. Two veins in slate and mica schist strike NW and dip NE; galena abundant.	Clark and Logan, 1962, p. 144
61	Columbia	T2N R13E Sec 11 SW 1/4	Lode Gold	Worked 1914-1916. Developed by 250 ft. shaft with levels at 100 and 200 ft. Ore treated in 5 stamp mill. Vein in quartz-ankerite zone with gabbro to east strikes NW and dips NE.	Tucker, 1916, p. 74; Logan, 1935, p. 137; Clark and Logan, 1962, p. 144

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
62	Commodore (Golden Gate)	T4N R12E Sec 7	Lode Gold	Active prior to and during the 1870's when it was worked through a 450 ft. adit. In 1899 a shaft was sunk, but property was idle until 1933 when some work was done on the 200 ft. level, with operations ceased in 1934. Amphibolite and a mineralized quartz diorite intrusion strikes NW and dips NE. Ore milled in 1900 contained an average of $4 per ton gold, with some $7 ore. Developed by a 300 ft. shaft.	Tucker, 1916, p. 82; Logan, 1935, p. 137; Clark and Logan, 1962, p. 51, 145
63	Cow Bell	T4N R13E Sec 22 SW 1/4	Lode Gold	Long idle. Developed by 300 ft. upper and 275 ft. lower W drift adits. A 4 ft. vein with sulfides in mica schist strikes W and dips 45°N.	Clark and Logan, 1962, p. 145
64	Crossette	T3N R12E Sec 26 E 1/2	Lode Gold	Active around 1914, 1929 and 1940. Developed by 80 ft. shaft. Quartz vein in slate strikes NW and dips NE.	Tucker, 1916, p. 75; Clark and Logan, 1962, p. 146
65	Crystal	T3N R13E Sec 33 NE 1/4	Lode Gold	Consolidated with Angels Mine 1886.	Clark and Logan, 1962, p. 146
66	Culbertson	T4N R12E Sec 8 NW 1/4	Lode Gold	Active 1896-1900. Developed by 120 ft. shaft and 400 ft. adit. Two veins in zone 34 ft. wide, strikes NW and dips NE; greenstone hanging wall and slate footwall.	Clark and Logan, 1962, p. 146
67	Curiosity	T2N R13E Sec 5	Lode Gold	No description is available.	
68	Curtis	T3N R13E Sec 29 NW 1/4	Lode Gold	No description is available.	
69	Dalmatia (Delmatia)	T4N R13E Sec 26 E 1/2	Lode Gold	Active around 1896-1900. Developed by 100 ft. adit and 200 ft. shaft. A zone 22 ft. wide, containing quartz veins and seams in slate, strikes NW and dips NE.	Crawford, 1896, p. 101; Tucker, 1916, p. 76; Clark and Logan, 1962, p. 146
70	Demarest	T3N R12E Sec 16 NE 1/4	Lode Gold	Originally worked in the 1850's and reportably had a large output by the late 1860's. Last worked in 1938-1939, with total output estimated at $75,000 at the old price of gold. There are three quartz veins on the property, but all of the work has been confined to the middle vein. It strikes in a northwesterly direction, dips to the northeast, and ranges from 6 to 10 ft. in thickness. Country rock is slate, phyllite, and smaller amounts of green schist. Gouge accompanies the vein on the hanging wall side north of the shaft, but some distance south of the shaft there is a flexing in the vein walls and the gouge passes over to the footwall side (Storms, 1900, p. 107). Present also are dikes of medium-grained diorite. The ore shoot south of the shaft had an average stope length of 225 ft. and contained an average of $8 to $9 per ton at the old price of gold. It has an hour glass shape as viewed laterally, the narrowest portion being on the 500 ft. level (D.C. Demarest, personal communication, 1957). The mine is developed by a 690 ft. 60 degree inclined shaft, with levels at 100, 300, 400, and 600 ft. Drifts range from 300 ft. to 420 ft. in length, and all have been driven south from the shaft. Besides the 10 stamps, the mill was equipped with amalgamation plates and Frue vanners.	Clark and Logan, 1962, p. 51, 146

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
71	Demarest	T3N R13E Sec 33 NW 1/4		No description in literature.	
72	Diamond Jack	T2N R11E Sec 14 NE 1/4	Lode Gold	Active 1896, worked through a 50 ft. shaft. A 9 ft. vein in greenstone strikes NW.	Clark and Logan, 1962, p. 147
73	Donnallan (Hageman)	T4N R12E Sec 6 or 7	Lode Gold	Active around 1896. Mined in open cut and treated in 15 stamp mill. A mineralized zone 40 to 200 ft. in width in weathered talcose slate and schist. Ore averaged $2.50 per ton.	Crawford, 1896, p. 102; Clark and Logan, 1962, p. 147
74	Economic (Cuneo)	T4N R13E Sec 34 NW 1/4.	Lode Gold	Developed prior to and during the 1880's, and active to 1918. The vein has an average thickness of 6 ft. strikes due west and dips 75°N. The ore contained free gold and abundant sulfides. Country rock is graphitic slate and mica schist. The mine is developed by a 700 ft. southeast crosscut adit to the vein from which nearly 1,000 ft. of drifts extend east on several levels and sublevels.	Tucker, 1917, p. 77; Clark and Logan, 1962, p. 52, 147
75	Edna	T5N R11E Sec 36 SE 1/4	Lode Gold	Active early 1890's. Developed by a 145 ft. shaft. Mineralization occurs in a dike 36 ft. in width, containing quartz.	Tucker, 1916, p. 77; Clark and Logan, 1962, p. 148
76	Esmeralda	T4N R13E Sec 34 N 1/2	Lode Gold	This gold mine was worked on a major scale beginning in 1885. In 1886-1887, it was reported to have yielded more than $1,000 per week from ore that contained an average of $32 per ton (Mining and Scientific Press, 4/24/86, p. 280, and 2/19/87, p. 128). The shaft was 250 ft. deep, and the ore was treated in a 10 stamp mill (Irelan, 1888, p. 133). Operations continued through the 1890's until sometime around 1900. The mine apparently has been idle for many years. The value of its total output is unknown, but several local residents estimate it to be in excess of $300,000. The vein strikes nearly due west, dips 68°N, and is 3 to 4 ft. thick. The ore contains free gold, with some sulfides. The country rock is graphitic slate containing numerous bodies of talc. Just to the south is green schist. The mine is developed by a 430 ft. inclined shaft and at least 500 ft. of drifts. The 10 stamp mill was equipped with a Frue vanner.	Crawford, 1896, p. 103; Tucker, 1916, p. 77; Clark and Logan, 1962, p. 52
77	Everlasting (Sceiffard)	T4N R12E Sec 19 E 1/2 Sec 20 NW 1/4	Lode Gold	Originally developed about 1867, the mine was intermittently active through the 1890's, and in 1900 a 225 ft. shaft was sunk. This deposit is one of several located on an irregular vein system in the San Andreas area of the Mother Lode which strikes northwestward and dips to the northeast. Much of the quartz has been crushed and mixed with gouge, and the gouge is heavy on both walls. The vein ranges from 8 to 14 ft. in width and ore mined in 1935 yielded $3 to $16 per ton. Total production unknown.	Fairbanks, 1890, p. 63; Tucker, 1916, p. 78; Logan, 1936, p. 242; Clark and Logan, 1962, p. 53
78	Extension	T2N R13E Sec 14	Lode Gold	See Carson Hill.	

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
79	Fellow Craft (Bodie, Veritas)	T4N R12E Sec 17 E 1/2	Lode Gold	This Mother Lode gold mine was discovered in 1852 (Mining and Scientific Press, 5/2/85, p. 288) and worked intermittently during the 1860's, 1870's, and 1880's. In 1893 it was reported to have had a total output of $100,000 (Preston, 1893, p. 178). The mine was active in 1900, and the ore was treated in a 10 stamp mill (Storms, 1900, p. 106). Apparently the last year of operation was in 1907 when the output was less than $1,000 (Logan, 1935, p. 139). There are two principal vein systems 100 to 135 ft. apart. Each consists of a series of quartz stringers containing free gold and sulfides. The west vein averages 2 ft. in thickness and the east vein 4 to 8 ft. The veins strike northwestward and dip to the northeast. Country rock is amphibolite and chlorite schist and just to the east is Calaver as slate. The mine is developed by a 230 ft. inclined shaft sunk on the west vein with levels at 50, 100, and 200 ft. On the 100-and 200- ft. levels, crosscuts extend to the east vein. There is also an adit on the west vein. The 10 stamp mill was equipped with Frue vanners and Wilfley table.	Brown, 1890, p. 149; Preston, 1893, p. 178; Tucker, 1916, p. 78; Logan, 1935, p. 138; Clark and Logan, 1962, p. 54, 150
80	Finnegan	T2N R13E Sec 13 SW 1/4	Lode Gold	See Carson Hill.	
81	Fontanac	T4N R13E Sec 27 NE 1/4	Lode Gold	Long idle. Worked through 60 ft. shaft and 230 ft. adit. Several veins in slate strike W and dip N.	Clark and Logan, 1962, p. 151
82	Ford (Apex)	T4N R12E Sec 17 SE 1/4	Lode Gold	Originally developed by ground sluicing prior to 1890's, and a 700 ft. shaft sunk in the 1890's. Property was intermittently active up to the late 1930's. The deposit is in a series of complexly folded beds of chloritic and amphibolitic schists (Knopf, 1929, p. 71). Black slate, talc schist, hornblendite, limestone, and garnetiferous white schist are present also. Four northwest-striking veins are on the property-the west vein, 120 ft. west of the main shaft; the main vein on which the main shaft was sunk; the hanging wall vein; and the east vein, which crops out 270 ft. east of the main shaft. The east and west veins were the richest and the latest work was concentrated at these localities (Logan, 1935, p. 139). The west vein is about 4 ft. thick, and the east vein is a belt of quartz stringers 20 ft. thick. The ore contains variable amounts of pyrite and smaller amounts of other sulfides. At one time hessite, petzite, and some rich gold specimens were recovered from the main vein. In the last operation the value of the mill heads ranged from $5 to $8 per ton (Logan, 1936, p. 257). The mine is developed by a 750 ft. inclined shaft sunk on the main vein with levels at 100, 200, 300, 400, and 700 ft.; a 120 ft. vertical shaft 300 ft. south of the main shaft; and several thousand ft. of drifts and crosscuts. The mill used in the last operation was equipped with a Hadsel impact breaker, a jig, and two flotation cells. It treated about 30 tons of ore per day. All equipment has been removed.	Clark and Logan, 1962, p. 54-55

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
83	Foster	T3N R13E Sec 33 NE 1/4	Lode Gold	No description available.	
84	Four Hundred	T4N R13E Sec 5, 6	Lode Gold	Active about 1914. Developed by 200 ft. shaft and crosscut adit. Vein in slate and graphitic schist.	Tucker, 1916, p. 109
85	Fricot Group	T4N R13E Sec 27 NW 1/4 Sec 28 NE 1/4	Lode Gold	Lode and Placer claims, long idle. Developed by shafts and adits. A series of E-striking and N dipping veins in mica schist.	Clark and Logan, 1962, p. 151
86	Gaston Hill	T4N R13E Sec 10 SW 1/4	Lode Gold	Active prior to and during 1880's and 1930's; intermittently prospected since. Developed by old caved 160 ft. shaft and newer open shaft. A 2 1/2 ft. wide vein in mica schist and slate strikes N80°W and dips N; contains free gold and sulfides. Ore mined in early operations yielded $15 per ton.	Clark and Logan, 1962, p. 152
87	German Ridge and Juniper Mine	T3N R13E Sec 15 SW 1/4	Lode Gold	Originally active prior to 1889, and intermittently through 1934. The quartz vein strikes in a NW direction, dips steeply to the NE, and ranges from 2 to 10 ft. in width. The mine is developed by a 140 ft. shaft with a level at 55 ft. Ore was treated in a 5 stamp mill.	Clark and Logan, 1962, p. 55, 152
88	Ghost	T3N R13E Sec 34 SW 1/4	Lode Gold	Active 1896 to around 1900, and 1921. Developed by 1,350 ft. and 350 ft. shafts. A vein as much as 20 ft. thick in amphibolite strikes NW and dips NE.	Tucker, 1916, p. 80; Logan, 1921, p. 424; Clark and Logan, 1962, p. 152
89	Gloy	T4N R13E Sec 7	Lode Gold	Long idle. Worked through 50 ft. adit. Two veins as much as 8 ft. thick with abundant sulfides. Strikes NW and dip s NE; slate and limestone country rock.	Clark and Logan, 1962, p. 153

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
90	Gold Cliff	T3N R13E Sec 33 SE 1/4.	Lode Gold	One of the better-known Mother Lode gold mines in the county, the Gold Cliff mine was discovered in 1850. The Utica Gold Mining Company gained control of the property in 1884 and operated it in conjunction with other mines until 1920. The value of the output for this period of operation was $2,834,000 (Logan, 1935, p. 141). Except for sampling the open cut in the 1930s, the mine has been idle since 1920. The deposit is in the main Mother Lode belt and consists of mineralized chlorite and amphibolite schist cut by numerous quartz veins and veinlets. The ore body was as much as 100 ft. thick. It strikes northwestward and dips to the northeast; at depth the dip flattens to as little as 7 degrees. The gold was associated with sulfides in the schist and quartz. The average value of the ore as mined ranged from $2.00 to $2.50 per ton and the sulfide concentrate from $30 to $50 per ton. In the upper workings the immediate hanging wall of the ore body was a massive barren quartz vein. At depth the hanging wall was hard, grooved amphibolite schist that stood without timbering and was a major factor in permitting low-cost mining operations (Logan, 1935, p. 140). Between the 1,600- and 1,700-ft. levels, a nearly horizontal fault of several hundred feet displacement offsets the ore body to the north. The Gold Cliff vein system intersects the Utica vein about 2,700 ft. below the surface in the Utica workings, but no high-grade ore was encountered at this intersection (Knopf, 1929, p. 72). The mine is developed by an open cut and a 1,700 ft. inclined shaft. A 270 ft. inclined winze was sunk from the 1,700 ft. level. A northeast crosscut on the 1,400 ft. level is connected with 1,500 ft. level of the Utica mine. Open stopes with pillars were employed; little timbering was required. The ore was treated in a 200 ton mill equipped with a Blake crusher, 40 stamps, and 24 Frue vanners.	Knopf 1929, p. 71; Logan, 1935, p. 140; Bowen, 1948, p. 56; Clark and Logan, 1962, p. 55, 153
91	Gold Hill	T3N R13E Sec 32 NW 1/4.	Lode Gold	This Mother Lode gold mine was originally worked during the early days of the gold rush when $100,000 was recovered from surface pockets (Mining and Scientific Press, 7/9/92, p. 28). After lying idle for some years it was reopened about 1890 by the Gold Hill Mining Company and operated until sometime around 1902. During this operation considerable amounts of ore were mined and treated in a 20 stamp mill. After 1902, mine was mostly idle, with some work in 1936. The vein, which ranges from 10 to 30 ft. in thickness, has a strike of about N35°W, and dips 60 to 70°NE. Country rock is chloritic amphibolite schist, dark massive fine-grained greenstone, and smaller amounts of phyllite and slate. The mine is developed by a steeply inclined 330 ft. shaft with levels at 165 and 300 ft.; and two adits, one a crosscut adit just to the west of the shaft, and a drift adit, the portal of which is some 200 yds. southeast of the shaft. The shaft and the adit portals are open. There are more than 3,000 ft. of drifts (Logan and Frank, 1936, p. 242). A considerable amount of stoping was done southeast of the shaft. There are also numerous open cuts and prospect holes in the vicinity.	Logan, 1936, p. 242; Clark and Logan, 1962, p. 56, 155

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
92	Golden Hill	T4N R11E Sec 1 SW 1/4	Lode Gold	Active during the 1870's when rich ore was reported to have been mined (Mining and Scientific Press, 3/3/77, p. 133). In 1896 the mine was developed by two shafts, 60 and 100 ft. deep (Crawford, 1896, p. 106). Although there are no published records, the mine was worked on a major scale following 1896. Extensive dumps indicate considerable development work, and according to several local residents, the mine had a large output. During the 1930's ore was mined from open cuts north and south of the main shaft and treated in the mill at the Lookout mine (Logan and Frank, 1936, p. 270). Apparently the mine has been idle since. The ore zone, which is as much as 8 ft. thick, consists of quartz and mineralized schist. It strikes N30°W and dips to the northeast. Country rock is slate and fine-grained chloritic schist. The ore contains free gold and auriferous pyrite. Ore milled in 1936 had a value of $1.70 to $3.50 per ton, and the concentrates averaged $90 per ton (Logan and Frank, 1936, p. 270). The mine is developed by a main 350 ft. inclined shaft that is partially open, two other open shafts 50 and 200 ft. to the southeast, and several open cuts.	Logan, 1936, p. 270; Clark and Logan, 1962, p. 55, 153
93	Gold Metal	T2N R11E Sec 24 NE 1/4	Lode Gold	Long idle. Developed by several open inclined shafts and open cuts. A 5 ft. vein of quartz stringers and pyritic chlorite-sericite schist strikes N15°W and dips 70°SW.	Clark and Logan, 1962, p. 154
94	Gold Metal	T2N R12E Sec 24 NE 1/4	Lode Gold	No description available.	
95	Golden Star	T2N R13E Sec 2 SW 1/4	Lode Gold	Long idle. Worked through a 70 ft. shaft and 120 ft. adit. Vein zone as much as 40 ft. thick in greenstone strikes NW and dips NE.	Clark and Logan, 1962, p. 154
96	Golden Star	T4N R13E Sec 16	Lode Gold	Long idle. Worked through a 40 ft. shaft. Vein as much as 11 ft. thick in slate strikes NW and dips NE.	Clark and Logan, 1962, p. 154
97	Gottschalk	T4N R12E Sec 7 SW 1/4	Lode Gold	Active prior to and during 1890's. Developed by 492 ft. shaft with crosscuts. A 2 to 20 ft. vein strikes NW and dips NE; slate footwall and amphibolite hanging wall.	Tucker, 1916, p. 83; Logan, 1936, p. 262; Clark and Logan, 1962, p. 155
98	Great Western	T3N R13E Sec 28 S 1/2	Lode Gold	Active in 1896-1897. Developed by 220 ft. shaft with three levels. Ore treated in 5 stamp mill. A 6 to 20 ft. vein in slate and greenstone strikes NW and dips NE.	Logan, 1935, p. 141; Clark and Logan, 1962, p. 156
99	Greek	T4N R13E Sec 14 W 1/2	Lode Gold	Long idle. Vein in quartz-mica schist strikes N.	Clark and Logan, 1962, p. 156
100	Gumboot	T4N R13E Sec 26 SE 1/4	Lode Gold	Active during Gold Rush with substanial output and again about 1905. Developed by 700 ft. adit and shaft. Vein in mica schist and slate strikes W and dips N.	Logan, 1936, p. 262; Clark and Logan, 1962, p. 156
101	Hale	T3N R13E Sec 33 NW 1/4	Lode Gold	See Angels Deep Group.	
102	Hardy	T2N R13E Sec 11 S 1/4 Sec 14 N 1/2	Lode Gold	Intermittently active from 1880's to 1923. Developed by 170 ft. shaft and 360 ft. adit. Quartz vein, with abundant sulfides in diorite and slate, strikes NW and dips NE.	Tucker, 1916, p. 86; Logan, 1925, p. 154; Logan, 1935, p. 142; Clark and Logan, 1962, p. 157

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
103	Hardscrable (Bullfrog)	T4N R13E Sec 6 NE 1/4	Lode Gold	Active 1928 and 1936. Developed by 100 ft. and 40 ft. shafts, and 300 ft. adit. Two narrow veins in slate strike E and dip S. Ore yielded up to $30 per ton.	Logan, 1936, p. 262; Clark and Logan, 1962, p. 157
104	Helen	T4N R11E Sec 13 SW 1/4	Lode Gold	Long idle. Developed by shaft. Vein in greenstone and slate strikes NW and dips NE.	Clark and Logan, 1962, p. 157
105	Hicks	T2N R13E Sec 10	Lode Gold	No description in available.	
106	Holland	T4N R12E Sec 20 S 1/2 Sec 29 NW 1/4	Lode Gold	Active 1896. Developed by 500 ft. crosscut adit. An 8 to 16 ft. vein strikes NW and dips NE, slate on hanging wall and greenstone on footwall.	Crawford, 1896, p. 108; Kerr, 1900; Tucker, 1916, p. 86; Clark and Logan, 1962, p. 158
107	Holy Ghost	T3N R13E Sec 34 S 1/2	Lode Gold	No description in available.	
108	Hostler	T4N R13E Sec 3 NW 1/4	Lode Gold	Long idle. Developed by adit. Vein in quartz mica schist strikes north.	Clark and Logan, 1962, p. 158
109	Hudson	T4N R11E Sec 11 SE 1/4	Lode Gold	Extensively mined in 1870's; active around 1893; prospected 1928-1929. Developed by 300 ft. and 100 ft. shafts and open cuts. A 3 to 5 ft. vein in slate and greenstone strikes N45°W and dips NE.	Tucker, 1916, p. 87
110	Ike Citron	T4N R11E Sec 36 E 1/2	Lode Gold	Active early 1900's. Worked through 125 ft. adit. Two veins as much as 10 ft. thick in greenstone, strike NW and dip NE.	Clark and Logan, 1962, p. 159
111	Illinois	T3N R12E Sec 16 N 1/2	Lode Gold	Active 1889 to 1900. Developed by 200 ft. inclined shaft with two levels. Ore treated in 10 stamp mill. Two veins, one striking N5°E, and the other N30°W, slate and schist country rock.	Tucker, 1916, p. 87; Logan, 1935, p. 148; Clark and Logan, 1962, p. 159
112	Iron Rock	T2N R13E Sec 14 SE 1/4	Lode Gold	See Carson Hill.	
113	Jackson	T4N R11E Sec 13 W 1/2	Lode Gold	Intermittently worked for pockets from about 1896 to 1913. Vein in slate strikes NW and dips NE; several intersecting veins.	Clark and Logan, 1962, p. 159
114	Jersey	T4N R11E Sec 26 NW 1/4	Lode Gold	Active early 1900's. Worked through 125 ft. adit. Two veins as much as 10 ft. thick in slate and greenstone strike NW and dips NE.	Kerr, 1900; Clark and Logan, 1962, p. 160
115	Jesus (Lopez)	T4N R13E Sec 33 N 1/2	Lode Gold	Active prior to 1914. Developed by 180 ft. shaft. Vein in mica schist strikes W and dips N.	Tucker, 1916, p. 92; Logan, 1936, p. 270; Clark and Logan, 1962, p. 164

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
116	K and J	T4N R13E Sec 34 NW 1/4	Lode Gold	Long idle. Developed by 100 ft. shaft and 150 ft. N crosscut adit. Vein in mica schist and slate strikes W and dips N.	Kerr, 1900; Tucker, 1916, p. 88
117	Kentucky House	T4N R12E Sec 29	Lode Gold	Active during 1890's. Developed by 160 ft. shaft vein in slate strikes NW and dips NE.	Kerr, 1900; Tucker, 1916, p. 88; Clark and Logan, 1962, p. 160
118	Keystone	T3N R13E Sec 29 N 1/2	Lode Gold	Long idle. Developed by vertical shaft. Quartz vein with pyrite strikes N55°W and dips NE, green schist footwall and phyllite hanging wall.	Clark and Logan, 1962, p. 161
119	La France	T2N R13E Sec 29 NW 1/4	Lode Gold	Active early 1900's. Worked through 65 ft. adit. Two veins 4 to 8 ft. thick in slate and greenstone strike NW and dip NE.	Kerr, 1900; Clark and Logan, 1962, p. 161
120	Last Chance	T3N R13E Sec 34 SW 1/4	Lode Gold	Active 1890's. Developed by 320 and 70 ft. shafts. Vein in green schist strikes NW and dips NE. Several rich pockets.	Crawford, 1896, p. 110; Tucker, 1916, p. 89; Clark and Logan, 1962, p. 161
121	Last Chance	T4N R13E Sec 18 S 1/4	Lode Gold	Active prior to 1936. Developed by 75 ft. and 200 ft. adits. Vein in quartz mica schist and slate.	Logan, 1936, p. 267; Clark and Logan, 1962, p. 161
122	Leonard	T4N R12E Sec 8 W 1/2	Lode Gold	Active 1888 to 1895. Developed by shaft and 400 ft. crosscut adit. Ore treated in 10 stamp mill. A vein in slate as much as 24 ft. thick strikes NW and dips NE.	Brown, 1890, p. 151; Crawford, 1896, p. 110; Clark and Logan, 1962, p. 162
123	Lightner	T3N R13E Sec 33 NE 1/4	Lode Gold	Discovered about 1857 and operated until 1915 with a total production of over $3,000,000. From 500,000 tons of ore.	Clark and Logan, 1962, p. 61
124	Lindsay	T3N R13E Sec 33 SW 1/4	Lode Gold	Discovered 1855, active 1882-88 and early 1900's. Developed by open cut and 100 ft. shaft. Vein strikes NW and dips NE; greenstone hanging wall, slate footwall.	Crawford, 1896, p. 111; Kerr 1900; Tucker 1916, p. 90; Clark and Logan, 1962, p. 162
125	Longworth	T3N R13E Sec 32 S 1/2	Lode Gold	No description is available.	

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
126	Lookout Mountain	T4N R11E Sec 1 SE 1/4 Sec 12 NE 1/4	Lode Gold	This Mother Lode gold mine probably was first worked many years ago. From 1931 to 1938 it was worked intermittently by the owners. A mill was erected which treated ore from this mine, the Golden Hill mine half a mile to the north, and the Etna mine. It was prospected again in 1946 but has been idle since. The deposit consists of a zone of quartz stringers and chloritic amphibolite schist as much as 60 ft. thick containing disseminated free gold, auriferous pyrite, and small amounts of chalcopyrite. The ore is low in grade; $1 to $3 in gold per ton is the average value, but the reserves have been estimated to be large (Julihn and Horton, 1938, p. 127). Concentrates ranged from $60 to $90 per ton in value, the vein zone strikes N10° to 20°W and dips 80°NE. Serpentine and pyroxenite lie to the east and Mariposa slate to the west. The mine is developed by a 50 ft. adit driven southeastward, 2,000 ft. of drifts and crosscuts and a 100 ft. winze with a level at 80 ft.	Kerr, 1900; Logan, 1936, p. 269; Julihn, 1938, p. 126; Clark and Logan, 1962, p. 164
127	Lost City Mine	T3N R11E Sec 27		No description in available.	
128	Lucky Boy	T3N R12E Sec 4 NW 1/4	Lode Gold	Intermittently prospected. Developed by two crosscut adits and drifts and 105 ft. inclined shaft. Little production. Vein on schist-serpentine contact strikes N.	Kerr, 1900; Tucker, 1916, p. 92
129	Lucky Jim and Gold Ridge	T4N R13E Sec 7 SW 1/4	Lode Gold	Prospected 1924 and 1934. Developed by shaft and adit. Vein in slate and mica schist.	Logan, 1936, p. 270; Clark and Logan, 1962, p. 164
130	Madison	T3N R13E Sec 33 SE 1/4	Lode Gold	This mine, which was originally known as the Lane and Tulloch, is on the Mother Lode just south of the Gold Cliff mine. It was worked on a small scale in the late 1870's and 1880's, and the ore was concentrated in arrastras (Mining and Scientific Press, 3/25/82, p. 188). Around 1887, the concern of Hobart and Hayward, which controlled the Utica mine and other properties in the area, purchased the mine. It was developed extensively and operated on a large scale during the 1890's. A 20 stamp mill was erected that later was increased to 40 stamps. The mine was shut down some time around 1900, and except for being dewatered in 1903, it has been idle since. The ore body, which is as much as 40 ft. wide, consists of gold-bearing chloritic amphibolite schist heavily impregnated with pyrite and cut by numerous quartz stringers. On the hanging wall lies a nearly barren quartz vein as much as 8 ft. wide. The ore body strikes in a northwesterly direction and has an average dip of 43 degrees to the northeast. The mine is developed by a 1,500 ft. inclined shaft with levels at each 100 feet. There are thousands of ft. of drifts, the longest of which connects with the Gold Cliff mine.	Logan, 1935, p. 144; Clark and Logan, 1962, p. 62, 165
131	Maloney	T3N R12E Sec 13 SW 1/4	Lode Gold	Active 1896. Developed by shaft. A 6 ft. vein with slate hanging wall and greenstone footwall strikes NW and dips NE.	Crawford, 1896, p. 112; Kerr, 1900; Clark and Logan, 1962, p. 165

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
132	Maltos and Mexican	T2N R12E Sec 30 N 1/2	Lode Gold	Gold produced from pockets prior to 1925 from vein which may be south extension of Mountain King vein. Quartz veins and auriferous greenstone strike NW and dip NE.	Logan, 1925, p. 155; Clark and Logan, 1962, p. 165
133	Maria and Fortuna	T4N R13E Sec 35 NW 1/2	Lode Gold	Active 1870's, 1894 and 1924. Developed by 650 and 400 ft. adits and 154 ft. shaft. Three veins in mica schist strike NW and dip NE.	Logan, 1925, p. 155; Logan, 1936, p. 271; Clark and Logan, 1962, p. 165
134	Marble Fay	T3N R13E Sec 32 S 1/2	Lode Gold	No description is available.	
135	Marble Springs Mine	T2N R13E Sec 10 NE 1/4	Lode Gold	See Mother Lode Central.	
136	Mark Hanna Quartz Mine	T3N R13E Sec 32 SE 1/4	Lode Gold	No description is available.	
137	Martha	T5N R13E Sec 34 NW 1/4	Lode Gold	Intermittently active 1899-1910. Developed by 52 ft. shaft. A 3 ft. quartz vein strikes N30°W.	Tucker, 1916, p. 92; Clark and Logan, 1962, p. 167
138	Melones (Carson Hill Group)	T2N R13E Sec 13,14	Gold	The Melones mine was a consolidation in 1895 of a group of mines that had worked since 1860. The Melones mine in the 1860's yielded rich ore carrying several tellurides including melonite ($NiTe_2$ with Co, Pb, and Ag) which was only on this claim and was named for it. The mine was first worked by shallow shafts and adits, which explored a 20 inch to 6 ft. quartz vein, and later by extensive underground workings and a large open cut. The Melones mine was best known for the large quantities of low-grade ore mined and milled at low costs. The Melones mine operated from 1895 to 1919 mining the low grade ore from these workings at an average cost of $1.60 per ton. The Melones mine is reported to have had a total production of $4.5 million at an average recovery of $2.70 per ton. The ore body consists of hydrothermally altered amphibolite schist, with pyrite, mariposite, and traversed by numerous quartz stringers. The ore body, which strikes northwest and dips 50°-70° to the northeast averaged 25 to 30 ft. in width and 480 to 660 ft. in length.	Crawford, 1896, p. 112-113; Kerr, 1900, p. 30; Tucker, 1916, p. 93-96; Logan, 1921, p. 422; Logan, 1925, p. 147; Logan, 1935, p. 133-135; Logan, 1936, p. 247-248; Julihn, 1938, p. 100-110; Bowen, 1948, p. 55; Clark and Lydon, 1962, p. 50, 167
139	Mester	T4N R11E Sec 14 NE 1/4	Lode Gold	Active prior to 1900. Developed by 90 ft. shaft and 125 ft. adit. A 4 ft. vein in slate strikes NW and dips NE.	Kerr, 1900; Tucker, 1916, p. 960; Clark and Logan, 1966, p. 167
140	Mid Winter	T2N R12E Sec 8	Lode Gold	Long idle. Worked through 30 ft. shaft and open cut. A 50 ft. vein zone with diorite hanging wall and slate footwall strikes NW and dips SW.	Kerr, 1900; Clark and Logan, 1962, p. 167
141	Missouri	T2N R13E Sec 11	Lode Gold	No description is available.	

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
142	Mohawk	T3N R13E NE 1/4	Lode Gold	Opened many years prior to 1924, the Mohawk mine was worked in 1924 and 1934 and has been prospected intermittently. By 1924 the mine had produced about $8,000 from a 200 ft. inclined shaft with levels at 100 and 200 ft. and shallow holes. The ore was treated in an electric 2 stamp mill. The mine follows a 3 ft. thick N42°W 64°NE pyritized quartz vein in light gray phyllite and light green slate.	Logan, 1925, p. 156; Logan, 1935, p. 145; Logan, 1936, p. 275; Clark and Lydon, 1962, p. 168
143	Morning Star	T2N R12E Sec 19 SE 1/4	Lode Gold	Active in 1890's and in 1935-1936 when about 2,000 tons of $5.35 per ton ore was mined. Development was by open pit and a 90 ft. inclined shaft. The mine follows NW striking NE dipping quartz veins in phyllite and schist.	Crawford, 1896, p. 102; Logan, 1936, p. 275-276; Clark and Lydon, 1962, p. 169
144	Mother Lode Central Group (Marble Springs)	T2N R13E Sec 3 SE 1/4 10 NE 1/4	Lode Gold	The mine was opened prior to 1900 and worked in the early 190Q's and again from 1935 to 1939. There are two veins on the property, one strikes NW and dips 55°NE, the other strikes W and dips 55°N. The NW striking quartz veins is about 15 ft. thick and has two inclined shafts sunk to depths of 200 and 600 ft. These shafts are connected by extensive underground workings. The west striking quartz vein has a 150 ft. inclined shaft sunk on it. The ore was reported to average $7.50 per ton in 1938 (Clark and Lydon, 1962). The host rock is phyllite, slate, and green schist of the Calaveras Formation.	Tucker, 1916, p. 72; Logan, 1936, p. 276; Julihn, 1938, p. 116; Clark and Logan, 1962, p. 64
145	Moutain King Mine	T2N R12E Sec 19 SW 1/4 30 NW 1/4	Lode Gold	This property was first active in the 1890's and by 1904 had been developed to an inclined depth of 500 ft. After being idle for some years it was reopened in 1930 and worked on a major scale from 1936 to 1941. By this time the shaft had been extended to a depth of 1,200 ft. and a new mill erected. During World War II, copper ore from Copperopolis was concentrated at the Mountain King mill. The mine was worked again from 1945 to 1948 by open-pit methods. The 5,000 ft. of underground workings are reported to have yielded in excessive of 300,000 tons of $8 per ton ore by 1940. This deposit is the northern portion of a mineralized zone that is estimated to be 4,000 ft. long and as much as 500 ft. wide along the Hobson fault. The vein system of quartz veins and stringers strikes N32°W and dips 30°NE. The mineralization is a quartz-sericite-pyrite alteration of the host greenstones and phyllites along with ankerite and mariposite.	Crawford, 1896, p. 114; Logan and Frank, 1936, p. 277; Clark and Lydon, 1962, p. 169
146	Mountain Ranch Road adit	T4N R12E Sec 24 N 1/2	Lode Gold	This mine consists of a 150 ft. + adit and a 40 ft. long open cut both of which trend S30°W. The workings follow an 18 inch thick quartz vein in graphitic phyllite and schist. The mineralization consists of minor pyritization of the host rocks and the quartz vein along transported hematite coating of the host rocks.	
147	Mount Timolus	T5N R12E Sec 36	Lode Gold	This mine consists of a 300 ft. deep shaft that was active in 1870's, 1887, and 1914. The mine had a 10 stamp mill at the time. The mineralization consists of gold and pyrite in a 2 ft. thick quartz vein that strikes NE and dips to the SE.	Tucker, 1916, p. 98; Clark and Lydon, 1962, p. 170

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
148	Murray Creek	T5N R13E Sec 33 SE 1/4	Lode Gold	This mine was active prior to 1896 and consists of a north striking quartz vein in quartz-mica schist.	Crawford, 1896, p. 114; Clark and Lydon, 1962, p. 170
149	Nellie	T2N R13E Sec 3 SE 1/4	Lode Gold	No description is available.	
150	New Discovery	T4N R13E Sec 7	Lode Gold	Worked prior to 1900, this mine consists of a 45 ft. shaft and a 35 ft. adit. The mineralization consists of gold and sulphides in 2 to 10 ft. thick quartz veins that strike NW and dip NE. The host rock is phyllite and schist.	Kerr, 1900; Clark and Lydon, 1962, p. 170
151	New Ford	T4N R13E Sec 26 SE 1/4 35 NE 1/4	Lode Gold	Reported to have been worked in the early 1960's, the mine is developed by a 100 ft. inclined shaft. The mineralization consists of a west striking and north dipping quartz vein in mica schist associated with a diorite dike. The gold occurs in small pockets in the quartz vein.	Clark and Lydon, 1962, p. 170
152	Norma	T3N R12E Sec 3 SE 1/4	Lode Gold	This mine was worked prior to 1900 by a 50 ft. deep shaft in phyllite, schist, and greenstone. The mineralization consists of a 50 ft. wide zone of quartz veins that strike NW and dip to the NE and contain gold with sulphides.	Kerr, 1900, p. 27; Clark and Lydon, 1962, p. 171
153	North Branch	T4N R11E Sec 13 SW 1/4	Lode Gold	Worked prior to 1900, this mine was developed by a 22 ft. deep shaft and a 50 ft. adit in slate and greenstone. The mine follows a 2 ft. quartz vein with gold and sulphides that strikes NW and dips NE.	Kerr, 1900, p. 27; Clark and Lydon, 1962, p. 171
154	North Star	T3N R13E Sec 33 S 1/2	Lode Gold	Reported to have been active in the 1880's and from 1909 to 1913, this mine was developed by a 480 ft. inclined shaft with levels at every 100 ft. The ore was treated in a 40 stamp mill. The shaft follows a 15 ft. thick zone of mineralized amphibiolite schist with abundant sulfides that strikes W and dips to the N.	Tucker, 1916, p. 98-99; Clark and Lydon, 1962, p. 171
155	Ohio	T2N R13E Sec 14 NW 1/4	Lode Gold	Active prior to 1900, this mine was worked through a 345 ft. deep shaft and a 300 ft. adit. The mineralization consists of a 4 to 20 ft. thick quartz vein that strikes N45°W and dips to the NE. The vein is at the contact between serpentine and a porphyritic hornblende dacite and can be traced for 300 ft. along strike. The quartz vein carries fine pyrite, blebs of galena, ankerite, and small amounts of sericite.	Kerr, 1900, p. 27; Clark and Lydon, 1962, p. 171
156	Oriole Consolidated	T2N R13E Sec 3 SW 1/4	Lode Gold	First mined as a surface mine early in the gold rush and yielded $30,000. It was then developed from 1897 to 1905 by a 900 ft. vertical shaft with levels every 100 ft. to the 600 ft level. The ore was treated in a 10 stamp mill. The mine follows a 10 to 50 ft. thick quartz vein in greenstone that strikes N and dips to the E. The quartz vein expands from 10 ft. on the surface to a thickness of 50 ft. at the 300 ft. level and has been explored for 400 ft. N and 500 ft. S at the 500 ft. level.	Tucker, 1916, p. 99-100; Logan, 1935, p. 145-146; Clark and Lydon, 1962, p. 172

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
157	Osborne (Belmont-Osborne)	T3N R13E Sec 30 SE 1/4	Lode Gold	First operated in 1850 as a surface mine with a 180 ft. shaft, the ore was treated in a 20 stamp mill until 1880. The property was again operated from 1929 to 1935, with $13,000 to $15,000 of output. During this period an inclined shaft was sunk to the 350 ft. level with crosscuts at the 70, 150, 350 ft. levels. The ore is reported to have averaged $10 to $14 per ton. The mineralized zone is about 75 ft. wide and contains at least 4 parallel quartz veins of 4 to 12 ft. in thickness, which strike N42°-55°W and dips 65°NE. The host rocks are phyllite, slate, and amphibolite schist that have been altered and pyritized surrounding the quartz veins. The veins contain quartz, chlorite, pyrite, calcite, and mariposite (?).	Logan, 1935, p. 146; Logan and Frank, 1936, p. 241-42; Clark and Lydon, 1962, p. 65-66, 172
158	Panuga	T3N R13E Sec 30 NE 1/4	Lode Gold	No description is available.	
159	Parnell	T3N R13E Sec 30 S 1/2	Lode Gold	This mine is just NW of the Osborne and is part of the Osborne-Belmont group (See: Osborne Mine).	Clark and Lydon, 1962, p. 173
160	Patsy Bob	T2N R13E Sec 25 NW 1/4 26 NE 1/4	Lode Gold	This mine was active prior to 1900 and from 1931 to 1937. The development consists of 450 ft. long open cuts, a 100 ft. adit, and a series of open cuts, shallow shafts and tunnels that have caved. The ore was treated in a 2 stamp mill and packed 1/2 mile by trail to a road. The mineralization consists of pyrite, chalcopyrite, arsenopyrite, galena, gold and some tellurides in 1/2 to 2 inch quartz veins in a zone 240 ft. wide. The zone strikes NE and dips SW in schist and slate.	Logan, 1936, p. 281-282; Clark and Lydon, 1962, p. 173
161	Pedro	T3N R12E Sec 4 NE 1/4	Lode Gold	Located near the Union mine, this mine was owned and worked in conjunction with the Union mine. (See: Union mine).	Logan, 1936, p. 292; Clark and Lydon, 1962, p. 173
162	Peirano (Santa Ana)	T2N R13E Sec 14 NE 1/4	Lode Gold	Worked in the 1890's by a 100 ft. vertical shaft, this mine follows a 2 ft. thick quartz vein in green schist that strikes NW and dips NE.	Crawford, 1896, p. 115, 119; Clark and Lydon, 1962, p. 173
163	Pine Cone	T5N R13E Sec 34 NW 1/4	Lode Gold	This mine consists of 40 ft. untimbered shaft that explores a 12 inch quartz vein in mica schist. The vertical vein strikes N30°W.	Clark and Lydon, 1962, p. 173
164	Pine Nut	T3N R13E Sec 19 SE 1/4	Lode Gold	Worked in 1884 and 1904, this mine was prospected again in the 1930's. Development consists of a 220 ft. shaft along with adits and open cuts in green talc-chlorite-schist and phyllite. The mineralization is gold and fine pyrites in a 5 inch quartz vein that strikes N45°-55°W and dips 65°NE. The host rocks adjacent to the vein has been silicified and pyritized as well.	Clark and Lydon, 1962, p. 138, 174
165	Pine Peak	T5N R11E Sec 36	Lode Gold	Worked prior to 1900, development was by a 15 ft. shaft and a 40 ft. open cut in greenstone and slate. The workings follow a 10 ft. thick quartz vein that contains gold along with sulfides. The vein strikes NW and dips to the E.	Kerr, 1900, p. 27; Clark and Lydon, 1962, p. 174

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
166	Pioneer	T4N R12E Sec 30 SW 1/4	Lode Gold	Discovered prior to 1900, this mine was worked intermittently from 1933 to 1940. The workings consist of a 160 ft. deep shaft, a 100 ft. long cut, an adit and two shallow shafts. The mine explores a 3 ft. quartz vein in pyritic kaolinized greenstone that strikes NW and dips to the NE. The vein contains free gold and 5 percent sulphides and was reported to assay $6 per ton in 1936 (Logan, 1936).	Logan, 1936, p. 282; Clark and Lydon, 1962, p. 174
167	Pioneer Chief	T4N R12E Sec 29 W 1/2	Lode Gold	Active from 1860's to 1889 and intermittently from 1916 to 1931, this mine was developed by a 125 ft. shaft and a 535 ft. inclined shaft with extensive underground workings. The workings explore a 40 ft. thick gouge zone that strikes N40°W, and dips to the E, and contains quartz veins ranging from veinlets to a 5 ft. thick quartz vein. The quartz veins and the host rock are silicified and contain pyrite.	Logan, 1935, p. 146; Clark and Lydon, 1962, p. 174
168	Providence	T4N R11E Sec 1 SE 1/4	Lode Gold	Developed by a 40 ft. shaft prior to 1900, this mine follows a 3 ft. thick shear zone that contains a brecciated quartz vein which strikes N20°W and dips steeply to the NE. The vein, which is in greenstone and slate, contains limonita and pyrite.	Kerr, 1900, p. 28; Clark and Lydon, 1962, p. 175
169	Pura Quill	T2N R13E Sac 4 NW 1/4	Lode Gold	Opened in the 1890's and worked again in the early 1930's, this mine has a 60 ft. shaft in slate and green schist. The mine is sunk on a quartz vein that strikes N45°W and dips NE.	Crawford, 1896, p. 116; Clark and Lydon, 1962, p. 175
170	Rathgeb	T4N R12E Sec 33 NE 1/4	Loda Gold	This mine was owned and operated in conjunction with the Union mine. This mine was active from the early 1850's until the 1870's. The ore, which was mined from a 220 ft. deep shaft, was treated in a 10 stamp mill. The pyritized quartz vein strikes N40°W and dips 70°E in slate, graphitic phyllite, schist and well silicified greenstone (See: Union mine).	Logan, 1935, p. 147; Clark and Lydon, 1962, p. 71, 176
171	Rathgeb Prospect	T4N R12E Sec 33 SE 1/4	Lode Gold	This prospect consists of four open pits up to 15 ft. deep, which explore quartz veins up to 12 inches thick phyllite, quartz rich schist, and tuffaceous greenstone. The quartz veins strike N25°W and dip 78°E and pyrite and to tha south maripoaita. The pyritization extends into the host rocks surrounding the veins.	
172	Relief	T2N R13E Sec 14 E 1/2	Lode Gold	Developed prior to 1896, this mine explores a large NW striking quartz vein in amphibolite schist. The quartz vein, which is adjacent to the Carson Hill mine, was worked for pockets of gold.	Crawford, 1896, p. 116; Clark and Lydon, 1962, p. 176
173	Reisler Ranch	T3N R13E Sec 32 SW 1/4	Lode Gold	No description is available.	
174	Romaggi and Costa	T2N R13E Sec 10 E 1/2	Lode Gold	Active prior to and during the 1890's, this mine was developed by 155 ft. shaft in phyllite and greenstone. Tha quartz vein, which strikes NW and dips NE is north along the same trend as the Carson Hill mine.	Crawford, 1896, p. 106, 117; Clark and Lydon, 1962, p. 177
175	Romaggi Family	T2N R13E Sac 10 E 1/2	Lode Gold	Developed prior to 1900, this mine explores a NW striking, NE dipping quartz veins in green schist.	Kerr, 1900, p. 28; Clark and Lydon, 1962, p. 177

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
176	Rose Hill (Rodesina)	T4N R13E Sec 5 S 1/2 8 N 1/2	Lode Gold	Worked from 1871 to 1892, the mine workings included a 700 adit, a 120 ft. shaft, and a 10 stamp mill. The mine follows a quartz vein that is up to 18 ft. thick, which strikes NW and dips to the NE.	Tucker, 1916, p. 102; Clark and Lydon, 1962, p. 177
177	Royal Mine Group	T2N R12E Sec 30 NE 1/4	Lode Gold	The largest and most productive mine in the West Gold Belt area. This mine started prior to 1883 and has worked almost continuously on some scale since that time. By 1905 the mine had been extended to a depth of 1,200 ft. by inclined shaft and a 120 stamp mill was built to process the ore. This mine and the adjoining Mountain King gold mine ore in the Hobson fault zone. This zone contains a series of parallel northwest-striking and northeast-dipping gold quartz veins and adjacent bodies of mineralized greenstone and schist (Clark, 1982). The mineralized zone is over 500 ft. thick and nearly 4,000 ft. long and contains at least five N50°W 3°NE quartz veins ranging from a few feet to as much as 20 ft. in thickness. The mineralization is contained in tha veins as well as the surrounding host rock which is greenstone that has been hydrothermally altered to ankerite-sericite-mariposite rock containing disseminated free gold and auriferous pyrite. Tha ore mined from 1895-1905, the greatest period of activity at the mine, is reported to have averaged $3.72 per ton (Tucker, 1916).	Tucker, 1916, p. 103; Logan, 1925, p. 157; Logan, 1936, p. 285-287; Clark and Lydon, 1962, p. 68-69, 178
178	Russell (Vista)	T2N R13E Sec 3 NW 1/4	Lode Gold	Worked from 1933 to 1936, this mine consists of a 350 ft. inclined shaft and 1,350 ft. of underground workings. The ore was treated in a 10 stamp mill. The ore comes from two veins, one striking eastwest and dipping 35°N and one striking N30°W and dipping 65°NE. The eastwest vein has been the most productive averaging $7 per ton (Logan, 1936). The mineralization consists of quartz veins containing gold, pyrite, and ankerite in amphibolite schist and slate.	Logan, 1936, p. 292-294; Clark and Lydon, 1962, p. 178
179	Sacramento	T3N R13E Sec 29 SW 1/4	Lode Gold		Clark and Lydon, 1962, p. 178
180	Safe Deposit	T3N R13E Sec 30 SW 1/4	Lode Gold	Active in tha 1870's and early 1890's, the mine was first developed by ground sluicing and then by a 100 ft. adit and a 40 ft. inclined shaft. Pyritization and silicification of a zone 10 to 20 ft. thick follows N26°W 80°NE quartz veins in sheared phyllite and schist. This mineralization and the shear zone extends from the Benson to the Yellowstone mines (See Benson and Yellowstone mines).	Crawford, 1894, p. 172; Clark and Lydon, 1962, p. 178
181	San Andreas	T4N R12E Sec 17 SW 1/4	Lode Gold	Prospected in the early 1900's by numerous shallow shafts, this mine explores a number of parallel veins that strike northwest in slate.	Tucker, 1916, p. 104; Clark and Lydon, 1962, p. 178

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
182	Sarah	T2N R12E Sec 24 SW 1/4	Lode Gold	This long idle property was developed by adit and shaft in 3 to 4 ft. thick silicified gouge zone that contains quartz, pyrite and limonite. The host rock is sheared and jointed serpentine and greenstone.	Clark and Lydon, 1962, p. 179
183	Seattle	T5N R11E Sec 36	Lode Gold	Developed prior to 1900 by several shafts and open cuts up to 40 ft. deep, the workings explore 4 to 10 ft. thick quartz veins in slate and greenstone that strike NW and dip NE.	Kerr, 1900, p. 28; Clark and Lydon, 1962, p. 179
184	Shotgun	T3N R12E Sec 16 SE 1/4	Lode Gold	Active in 1899, 1914, and 1930, this mine is developed by several shafts up to 125 ft. deep. These workings follow a zone of quartz veins and veinlets with pyrite that strike N12°W and dips 80°NE. The host rock is grey phyllite, quartz-rich schist and slate.	Tucker, 1916, p. 106; Logan, 1935, p. 147; Clark and Lydon, 1962, p. 180
185	Specimen	T3N R12E Sec 3 W 1/4	Lode Gold	Developed prior to 1900 by a 400 ft. adit and open cut, this mine was operated in association with the Burgess and Pedro mines and these follow the same trend as the Union mine to the north. The mineralization consists of a 50 ft. thick zone of silicified and pyritized greenstone (tuffs?) and micaceous schist that contain quartz veins up to 12 inches thick. This zone strikes N40°W and dips to the NE and the quartz veins appear to contain up to 7 or 8 percent pyrite.	Kerr, 1900, p. 28; Logan, 1936, p. 292; Clark and Lydon, 1962, p. 181
186	Starlight	T4N R13E Sec 17 SW 1/4	Lode Gold	Active prior to and during early 1890's; 1940's and early 1950's, this mine was developed by a 145 ft. vertical shaft sunk in well-foliated quartz-chlorite schist. The shaft explores a 1 1/2 to 3 ft. pyritized quartz vein with 3 to 6 inches associated veinlets that fill a 3 to 8 ft. thick N80°W vertical shear zone.	Tucker, 1916, p. 107; Clark and Lydon, 1962, p. 181; Crawford, 1986, p. 120
187	Star of India	T3N R13E Sec 31 SE 1/4	Lode Gold	Active in the 1890's, this mine was developed by a 360 ft. adit and two 50 ft. shafts. The workings explore a 40 to 50 ft. thick zone of quartz veins up to 40 ft. wide that strikes NW and dips NE.	Crawford, 1896, p. 120; Crawford, 1948, p. 97; Clark and Lydon, 1962, p. 181
188	Starvation	T4N R12E Sec 13 SE 1/4	Lode Gold	Worked prior to 1900, the mine explores a 4 ft. thick N65°W 74°NE quartz vein in gray phyllite and schist. The workings consists of a 25 ft. deep shaft (caved) on a pyritized quartz vein.	Kerr, 1900, p. 30; Clark and Lydon, 1962, p. 182
189	Sugar Pine	T3N R13E Sec 2 N 1/2	Lode Gold	Developed by a 100 shaft, 55 ft. open cut, and a 50 ft. adit from 1897 to 1902, the workings follow a 4 ft. thick quartz vein that strikes N85°E and dips 70°SE. The mineralization consists of minor limonite and pyrite in the quartz vein.	Kerr, 1900, p. 29; Clark and Lydon, 1962, p. 182
190	Sunny Side	T2N R13E Sec 23 SW 1/4	Lode Gold	No record of production or development, the mine explores a quartz vein in phyllite and greenstone that strikes NW and dips NE.	Clark and Lydon, 1962, p. 183
191	T a b l e Mountain	T4N R13E Sec 3 NW 1/4	Lode Gold	Developed by a 110 ft. shaft prior to 1900, this mine explores a 1 1/2 to 2 ft. quartz vein that strikes N30°E and dips 80°SE in quartz mica schist.	Kerr, 1900, p. 30; Clark and Lydon, 1962, p. 183

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
192	Thomas Brothers Claim	T4N R13E Sec 23 NE 1/4	Lode Gold	Active in the 1930's, these claims were developed by short adits up to 100 ft. long and open cuts. The mineralization consists of 3 to 15 ft. quartz veins that strike N and E, which are reported to carry gold and sulphides with some high-grade pockets (Clark, 1962).	Logan, 1936, p. 277; Clark and Lydon, 1962, p. 183
193	Thorpe	T3N R12E Sec 11 SW 1/4	Lode Gold	Started in the 1860's, the Thorpe mine had a 637 ft. inclined shaft, extensive underground workings, and a 30 stamp mill by 1898. The mine, which was last worked in 1930, had an unknown amount of production. The deposit consists of a zone of parallel N60°W 53°NE quartz veins and stringers in amphibolite and chlorite schist. The veins contain pyrite, calcite, and some ankerite. Most of the mineralization lays on the periphery of the vein and in the adjoining host rock (Logan, 1935).	Tucker, 1916, p. 109; Logan, 1935, p. 143; Clark and Lydon, 1962, p. 70-71, 184
194	Tip Top	T3N R12E Sec 3 SE 1/4	Lode Gold	Developed prior to 1900 by a 25 ft. shaft and 120 ft. open cut, the vein is reported to be as much as 50 ft. thick and to strike NW and dip to the NE.	Kerr, 1900, p. 28; Clark and Lydon, 1962, p. 184
195	Tisconia	T2N R12E Sec 17 NE 1/4	Lode Gold	Developed as a series of small prospect pits and open cuts in metavolcanics (meta tuffs?), epidotized greenstone, and slates, the pits expose metavolcanics that have been pyritized (1 to 2 percent) and silicified with occasional stockwork quartz.	
196	Tollgate (Port Arthur)	T3N R13E Sec 32 NE 1/4	Lode Gold	Active prior to 1892, this mine last produced about 1925 when about 40 tons of ore yielded $7.50 per ton. The mine consists of a 150 ft. inclined shaft with development on the 100 and 150 ft. levels. The mineralization consists of a 5 ft. thick zone of silicified and pyritized greenstone and schist, that trends N32°W 80°NE and contains quartz veins up to 3 ft. wide.	Tucker, 1916, p. 101; Logan, 1925, p. 159-60; Logan, 1935, p. 148; Clark and Lydon, 1962, p. 184
197	Triple Lode	T3N R13E Sec 32 SE 1/4	Lode Gold	First worked by ground sluicing in the 1880's, by 1898 a 450 ft. deep shaft had been sunk. From 1920 to 1924 another shaft was sunk 560 ft. and extensive work was done underground. The Triple Lode mine lies on the same vein system as the Wagon Rut, Gold Hill, and Pernell mines to the NW. The N45°W55°NE quartz vein ranges from 12 to 20 ft. in thickness and consists of pyrite (3 percent), arsenopyrite, calcite, and ankerite in greenstone, quartz chlorite schist, and phyllite.	Tucker, 1916, p. 70; Logan, 1925, p. 160; Logan, 1935, p. 148-49; Clark and Lydon, 1962, p. 71, 184; Crawford, 1986, p. 98
198	Tullock	T2N R13E Sec 11 SW 1/4	Lode Gold	Started prior to 1890, by 1900 the shaft was 250 ft. deep in chlorite-talc schist, slate and phyllite. From 1909 to 1917 the shaft was extended to 800 ft. deep. The mine explores a quartz vein several feet thick in a 30 ft. wide zone of mineralization. The mineralization consists of pyrite, sericite, galena and mariposite in the quartz vein and the surrounding host rock. This was reported to have an unusually high amount of galena for a Mother Lode mine (Tucker, 1916).	Crawford, 1896, p. 121; Tucker, 1916, p. 110; Logan, 1925, p. 160; Logan, 1935, p. 149; Logan, 1936, p. 291; Clark and Logan, 1962, p. 71, 185;

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
199	Union mine	T4N R12E Sec 33 E 1/2	Lode Gold	Developed by an inclined shaft 455 ft. deep, the Union mine was first worked in the late 1860's until the 1890's. In 1887 a rich gold pocket was discovered at the 120 ft. level, which yielded more than $23,000. In the quartz and associated with the gold were black acicular crystals of uraninite with yellow uranium oxide (Logan, 1935). In 1954, the Uravan Uranium and Oil Co. explored the union shaft, but only produced small amounts of gold. The total amount of output is unknown, but it is reported that the Rathgeb brothers recovered $175,000 between 1860's and 1880 (Knopf, 1929). The Union quartz vein has a strike of N30°W and dips 70°NE. The mineralization consists of pyritization from 1 percent to several percent in the 12 to 6 inch quartz veins and in the surrounding host rock, which is green phyllite, dark greenstone, and dark gray schist. In addition to pyritization, calcite has flooded the host rocks forming 4 to 6 inch veins along with ankerite and hematite.	Crawford, 1896, p. 116; Kerr, 1900, p. 30; Tucker, 1916, p. 110; Knopf, 1929, p. 71; Logan, 1936, p. 291-92; Clark and Lydon, 1962, p. 71-72, 185
200	Unnamed	T2N R13E Sec 1 NW 1/4	Lode Gold	This mine consists of a caved adit in gray phyllite. The adit follows a 6 inch shear zone, which strikes N80°E and dips near vertical. The mineralization consists of a 2 inch quartz vein, which fills the shear and contains less than 1/2 percent pyrite.	
201	Unnamed	T3N R12E Sec 3 NE 1/4	Lode Gold	Developed by a 50 ft. adit in a micaceous quartz schist, the mine follows a 4 to 6 inch thick quartz vein that appears to strike N30°W and dips 65°N. The quartz vein and adjacent host rock contain scattered pyrite (less than 1/2 percent).	
202	Unnamed	T3N R12E Sec 23 SE 1/4	Lode Gold	Developed by a shaft of unknown depth in metavolcanics, gray phyllite, micaceous schist, the shaft explores a 3 ft. shear zone that contains 1 to 3 inch quartz veins and massive pyrite and limonite. The zone strikes N52°W and dips 64°NE.	
203	Unnamed	T3N R13E Sec 16 SE 1/4	Lode Gold	Developed by a 100+ ft. adit in talc-chlorite schist, metagraywacke, and black graphitic schist, the adit explores a N70°W-65°SW shear zone that contains 6 inch thick quartz veins. The host rocks adjacent to the veins are silicified and pyritized (5 percent).	
204	Unnamed	T3N R13E Sec 26 NE 1/4	Lode Gold	Developed by a 100+ ft. adit in dark micaceous schist, this mine follows a N45°W striking 12 inch quartz vein containing scattered pyrite.	
205	Unnamed	T4N R12E Sec 31 NW 1/4	Lode Gold	This mine, which is located near the Ike Ciron mine, consists of a 40 ft. open cut in talc schist, metavolcanics, gray-wacke, and quartz metaconglomerate. The metavolcanics contain a small amount of scattered pyrite crystals.	
206	Unnamed	T4N R12E Sec 8 SW 1/4	Lode Gold	Developed by an east trending adit of unknown length, this mine follows a quartz vein in micaceous quartz schist that has been feeably pyritized (1/2 percent).	
207	Unnamed	T4N R13E Sec 14 NE 1/4	Lode Gold	Developed by a vertical shaft and several prospect pits, the mine explores a 5 ft. thick shear zone in quartzite and metapellite. The shear zone contains a quartz vein that has limonite after pyrite scattered through it.	

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
208	Unnamed	T4N R13E Sec 26 NE 1/4	Lode Gold	Developed by two adits in graphitic slate, the mine follows a N50°W 10 ft. wide shear zone that contains a 6 inch thick quartz vein. The quartz vein contain sericite and limonite.	
209	Unnamed	T4N R13E Sec 27 NE 1/4	Lode Gold	Developed by a series of open cuts, this mine follows a N35°E striking southeast dipping quartz vein in graphitic slate. The mineralization consists of scattered pyrite in the host rock adjacent to the vein and in the vein next to the host rock.	
210	Unnamed	T4N R13E Sec 27 NE 1/4	Lode Gold	Developed by a 60 ft. shaft and a series of open cuts and pits, the mine explores a 3 ft. that trends N50°E70°SEquartz vein in graphitic schist and phyllite. The mineral-ization is minor pyritization along the contact between the host rock and the quartz vein.	
211	Unnamed	T5N R13E Sec 34 NW 1/4	Lode Gold	Developed by a number of shafts some at least 50 ft. deep and several adits, the mine follows a 10 ft. thick N50°W vertical shear zone in a gray quartz mica schist. The mineralization consists of scattered pyrite and limonite in 4 to 12 inch quartz veins that fill the shear zone.	
212	Utica mine	T3N R13E Sec 34 W 1/2	Lode Gold	First worked in the 1860's, the greatest development at the Utica mine was between 1880's and the 1890's when the mine reached a depth of 1,470 ft. During the 1890's the Utica was one of the most productive gold mines in the nation producing more than 4 million dollars (approximately 48 million dollars in 1987 dollars) from January 1893 to September 1895. At this time more than 500 men were on the payroll. By 1915 when the mine closed, development in the mine had reached a depth of 3,050 ft. and the underground workings consists of over 100 miles of crosscuts, drifts, and declines. The total production is valued at $17,000,000 at the old price of gold (Bowen and Crippen, 1948). The ore bodies consist of lenticular quartz and calcite veins separated by various thickness of sheared amphibolite, chlorite and talc schists. Both the quartz-calcite veins and the nearby host rock contain free gold and auriferous pyrite. The shear zones are reported to strike northwest and dip from 70°-90°NEand to range in thickness from 20 to 90 ft. (Clark, 1962).	Crawford, 1894, p. 98-99; Crawford, 1896, p. 121-122; Kerr, 1900, p. 30; Tucker, 1916, p. 110-112; Logan, 1935, p. 149-151; Bowen and Crippen, 1948; Clark and Lydon, 1962, p. 72-73
213	Vonich	T2N R13E Sec 21 NW 1/4	Lode Gold	Active around 1903, this mine was developed by an adit and a 195 ft. inclined shaft in slate and green schist. The quartz vein that the mine follows strikes N25°W and dips 60°NE.	Tucker, 1916, p. 112; Clark and Lydon, 1962, p. 186
214	Wagon Rut	T3N R13E Sec 32 W 1/2	Lode Gold	Active around 1900's about the same time as the adjacent Triple Lode and Parnell. This mine was developed by an inclined shaft in phyllite and quartz mica schist. The quartz vein the mine follows strikes N60°W and dips 70°-80°NE. The quartz vein carries scattered pyrite.	Clark and Lydon, 1962, p. 186
215	Waterman	T2N R13E Sec 3 NW 1/4	Lode Gold	Developed by 225 ft. inclined shaft about 1914, this prospect was diamond drilling to a depth of 1,000 ft. with reported good assays to a depth of 300 ft. The shaft follows a 5 ft. quartz vein that contains quartz and ankerite in green schist and metagabbro. The vein strikes N20°W and dips 55°NE.	Tucker, 1916, p. 112; Logan, 1935, p. 151; Clark and Lydon, 1962, p. 187

MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
216	Wheelock	T4N R13E Sec 23 NE 1/4	Lode Gold	Developed by three adits, the longest being 1,000 ft. long. This mine was worked in the 1860's, 1920's and 1930's, and intermittently prospected since then. The total output of the mine is reported to be $300,000 (Clark, 1962) most of which was treated in a 10 stamp mill on the site. The mine explores a 1 to 6 ft. quartz vein containing abundant pyrite, that strikes N and dips 80°E.	Crawford, 1896, p. 123; Tucker, 1916, p. 112; Clark and Lydon, 1962, p. 187
217	Whittle	T2N R13E Sec 14 W 1/2	Lode Gold	Developed by two inclined shafts to a depth of 200 ft. This mine was worked extensively from 1889 to 1895. It was prospected again about 1914 and during the 1930's. Ore mined in 1889 yielded $10 to $12 per ton in gold (Clark, 1962). The mine explores a 3 ft. thick quartz vein that strikes N35°W and dips 70°NE in phyllite and green schist. Pyrite and calcite along with arsenopyrite are found both in the quartz vein and in the adjacent country rock.	Crawford, 1894, p. 99; Crawford, 1896, p. 123; Tucker, 1916, p. 113; Clark and Lydon, 1962, p. 74, 187
218	Wonder	T4N R13E Sec 18 SW 1/4	Lode Gold	Active prior to 1900, this mine was developed by two shafts, 25 ft. and 45 ft. deep, and one open cut 40 ft. long in graphitic phyllite and schist. The mine explores two 2 to 10 ft. thick quartz veins that strike N66°W and dips 85°NE. The veins contain scattered pyrite along the borders with most of the mineralization (1/2 percent pyrite) contained in the host rock adjacent to the vein.	Kerr, 1900, p. 32; Clark and Lydon, 1962, p. 188
219	Yellowstone	T3N R13E Sec 30 W 1/2	Lode Gold	Active prior to 1892, this mine along with the Safe Deposit and Benson has been prospected in recent years. Developed by several shallow shafts in micaceous phyllite and schist, the yellowstone explores a 10 to 20 ft. thick zone of silicification and pyritization that contains small quartz veins striking N26°W and dipping 80°NE. The veins are reported to contain tellurides (Clark, 1962).	Crawford, 1894, p. 100; Crawford, 1896, p. 123; Clark and Lydon, 1962, p. 188
220	Agostine	T4N R11E Sec 2 SE 1/4	Lode Gold	Located on the Deep Blue Lead, this drift mine was active in 1890's. It was developed 200 ft. deep with a short drift at the bottom, which trends N70°E.	Crawford, 1896, p. 97; Lindgren, 1911, p. 209; Clark and Lydon, 1962, p. 189
221	Altaville	T3N R13E Sec 21 NW 1/4	Placer Gold	First developed by a 358 ft. vertical shaft in 1939-1942, the Altaville mine has about 400 ft. of drifts driven at the bottom of the vertical shaft. This mine has worked intermittently since that time exploring the Central Hill channel about a mile down-stream from the Calaveras Central Drift mine. The gravel is well cemented and consists of boulders and cobbles of chert, quartz, granitic rock, and schist that rests on greenstone and schist of the Calaveras Formation.	Clark and Lydon, 1962, p. 84-85, 189
222	Austrian (Preston mine)	T4N R12E Sec 30 SE 1/4	Placer Gold	Developed by a vertical shaft over 45 ft. deep in 1848, this mine has operated intermittently since that time.	
223	Barnhardt	T4N R12E Sec 25 SE 1/4	Placer Gold	Active 1897 to 1901, this hydraulic mine is reported to have washed about 17,000 yds. of gravel.	Clark and Lydon, 1962, p. 190

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
224	Blue Gravel	T4N R11E Sec 2 NE 1/4	Placer Gold	Located on the Deep Blue Lead, this drift mine was active prior to 1900 and has worked intermittently in the 1930's. Development consists of a 115 ft. vertical shaft and 500 ft. of drifts west, northwest, and north of the shaft. This mine follows blue gravel on a slate bedrock capped by volcanic tuff. Tertiary stream crossing over flat bedrock here has cut several channels.	Kerr, 1900, p. 32; Logan, 1936, p. 327; Julihn, 1938, p. 66; Clark and Lydon, 1962, p. 190
225	Buck (Chapman, Plug Ugly)	T4N R12E Sec 21 SE 1/4	Placer Gold	Located on the Central Hill channel, this drift mine was active in the 1930's and was developed by a 200 ft. inclined shaft with 820 ft. of drifts. The channel trends N40°W and where the grade flattens the pay gravel increases to a width of 20 to 40 ft. and is 6 ft. thick. The pay gravel consists of 50 percent large boulders capped by 170 ft. of volcanic ash. The gold is medium to coarse grained.	Tucker, 1915, p. 115-116; Julihn, 1935, p. 71; Clark and Lydon, 1962, p. 191
226	Bully Boy	T3N R13E Sec 8 SW 1/4	Placer Gold	This mine was worked prior to 1900 by 25 men, who worked a 70 ft. high bank by hydraulic equipment. In the early 1900's a 120 ft. shaft was sunk.	Kerr, 1900, p. 32; Clark and Lydon, 1962, p. 191
227	Calaveras Central	T3N R13E Sec 28 NE 1/4	Placer Gold	First worked prior to 1900, this consolidation of mines is developed by a series of vertical shafts about 200 to 300 ft. deep. The 30,000 ft. of underground workings explore a series of channels that made up the Central Channel. For the most part, the gold is well worn and of large size in the Central Hill channel. The gold is generally found within the lower 5 ft. of the gravel and upper 2 ft. of the bedrock, which is slate and schist of the Calaveras Formation. The width of the pay gravel is from 50 to 250 ft. and consists of tightly cemented, well-rounded pebbles, cobbles, and boulders of granite, granodiorite, and quartz. In the channels the gold is associated with considerate pyrite and a little black sand. The total yield of the mines between 1900 to 1937 was reported to be 22,000 ounces (Clark, 1962). The gravels are very well cemented and because of this most of the drifts require little or no timbering.	Logan, 1936, p. 329-330; Julihn, 1938, p. 42-58; Clark and Lydon, 1962, p. 85-87, 191
228	Calaveras Hill Consolidation	T4N R12E Sec 35 SE 1/4	Placer Gold	Located on the Central Hill channel, this hydraulic mine operated in 1901, 1906, 1910, and 1936-1939. Approximately 44,000 yds. of gravels were washed from 1901 to 1939. This material was washed from a 75 ft. high, 600 ft. long bank that has estimated reserve of 4 million cubic yards averaging $.30 (1936) per yard. The gravel is tight, not well cemented, free of large boulders and rests on soft slate bedrock (Clark, 1962).	Tucker, 1915, p. 115; Logan, 1936, p. 332-333; Julihn, 1938, p. 93-94; Clark and Lydon, 1962, p. 192
229	Calmo (Slab Ranch)	T3N R13E Sec 27	Placer Gold	This property, situated on the Central Hill channel, was prospected in the 1800's, but was not seriously worked until 1922. Development was by three vertical shafts of 45 ft., 115 ft., and 167 ft. respectively with over 8,000 ft. of drifts driven along the gravel bedrock contact. The mine was worked from 1922 to 1933 and yielded about $25,000 of gold at 1936 prices. The channel is about 70 to 125 ft. wide at this point and consists of cobbles of schist, quartzite, basalt (?), and rhyolite.	Logan, 1924, p. 7, 178; Logan, 1925, p. 161; Logan, 1936, p. 351; Clark and Lydon, 1962, p. 91-92, 206

MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
230	Canepa (Golden Queen)	T3N R13E Sec 26	Placer Gold	Located on the Central Hill channel, this drift mine was developed in 1935 to 1937 by 116 ft. vertical shaft with 265 ft. of drifts. The drifts show a maximum thickness of 30 ft. of gravel with minor amounts of gold.	Logan, 1936, p. 343; Clark and Lydon, 1962, p. 197
231	Central Hill Consolidation	T4N R11E Sec 11 SE 1/4 12E SW 1/4 13E NW 1/4	Placer Gold	Located on the Central Hill channel, this drift mine was developed in the middle to late 1930's by a 370 ft. inclined shaft trending N70°E with 1,000 ft. of drifts. The channel consists of semi-cemented gravel with numerous boulders encrusted with pyrite interbedded with sand layers in a 50 to 70 ft. wide and 20 ft. thick channel. The gravels rest on slate bedrock and 3 ft. of gravel with the gravel averaging $2 to $3 in gold.	Logan, 1936, p. 335; Clark and Lydon, 1962, p. 193
232	Chappellet	T5N R11E Sec 35 N 1/2	Placer Gold	Located on the Chili Gulch channel, this drift mine was active prior to 1893 and in 1895 by a 1,100 ft. adit. The gravels contain rhyolite fragments and are overlain by rhyolite tuffs.	Crawford, 1896, p. 103; Lindgren, 1911, p. 209; Logan, 1925, p. 161; Logan, 1936, p. 339; Clark and Lydon, 1962, p. 193
233	Chris Anderson	T4N R12E Sec 21 SE 1/4	Placer Gold	Located on the Central Hill channel, this drift mine was developed in 1904 and worked in 1935-1937, by a 100 ft. vertical shaft with 450 ft. of bedrock tunnel and 500 ft. of drifts in gravel. The channel is 280 ft. wide and 63 ft. deep with pay gravel being 150 ft. wide and 7 ft. deep at the bottom of the channel. The mine is reported to have yielded 10,000 ounces of gold prior to 1906 (Clark, 1962).	Tucker, 1915, p. 122; Logan, 1936, p. 352; Julihn, 1938, p. 72-73; Clark and Lydon, 1962, p. 193
234	Coffee Mill (Gleason, Golden Gate)	T5N R11E Sec 35 NW 1/4	Placer Gold	Located on the Kraemer channel, this drift mine was first active in 1866 with a 400 ft. inclined adit. The pay gravel was 100 ft. wide and by 1868 the mine was producing 200 carloads per day of gravel. Between 1880 and 1884 another inclined adit and 2,300 ft. of additional drift was driven.	Crawford, 1896, p. 101; Tucker, 1915, p. 116; Clark and Lydon, 1962, p. 87, 194
235	Cuneo Batholomew	T4N R13E Sec 10 W 1/2	Placer Gold	Located on the El Dorado channel, this hydraulic mine was active prior to 1911 and mined a steep-sided channel with 25 ft. of auriferous gravel capped by 10 ft. of clay, ash, gravel and soil. This mine was worked again in the 1930's by dragline dredge.	Lindgren, 1911, p. 211; Tucker, 1915, p. 118; Clark and Lydon, 1962, p. 195
236	Eastland Gray Development Co.	T5N R12E Sec 31	Placer Gold	The hydraulic mine worked from 1905 to 1912 during which time $80,000 is said to have been recovered. The mine was prospected again in 1914 when gravels from crevices in the underlying limestone were sluiced.	Tucker, 1915, p. 117; Clark and Lydon, 1962, p. 195
237	Foley	T5N R13E Sec 32 NW 1/4	Placer Gold	Located on the El Dorado channel, this drift mine was active prior to 1900.	Clark and Lydon, 1962, p. 194
238	Glenn	T5N R13E Sec 31 NE 1/4	Placer Gold	This hydraulic mine was active from 1922 to 1925 and worked several gravels, the largest being 50 ft. wide by 6 ft. deep. The mine washed an estimated 6,700 yds. of gravel.	Logan, 1923, p. 18; Clark and Lydon, 1962, p. 197

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MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
239	Gold Treasure	T3N R13E Sec 17 S 1/2	Placer Gold	Located on the Central Hill channel, this drift mine was developed by a N50°W trending adit along the contact between well-cemented alluvial gravels overlying schists of the Calaveras Formation.	
240	Gunter and Hartlief	T4N R13E Sec 20 NW 1/4	Placer Gold	Located on the Fort Mountain channel, this drift mine was active in the 1850's, when several shafts were sunk 40 to 100 ft. deep. The pay gravel is 5 to 7 ft. thick at a depth of 25 ft.	Clark and Lydon, 1962, p. 198
241	Hedrick	T4N R12E Sec 28 NE 1/4	Placer Gold	Located on the Central Hill channel, this drift and hydraulic mine was active prior to 1872, again in 1900's and last in 1910's. The mine was developed by hydraulic pits, five shafts 50 to 120 ft. deep, and three adits 400 ft. long. About 7,000 yds. of gravel were washed from two channels, one shallow channel 400 ft. wide and the other 8 ft. deep and 100 ft. wide.	Lindgren, 1911, p. 203-204; Tucker, 1915, p. 118 Clark and Lydon, 1962, p. 199
242	Humbolt	T4N R13E Sec 9 NE 1/4	Placer Gold	Located on the El Dorado channel, this hydraulic mine was developed by a shallow pit 10 ft. deep by 200 ft. wide and 300 ft. long. The gravel consists of sub- rounded schist, quartzite, and minor quartz on black schist bedrock.	Clark and Lydon, 1962, p. 199
243	Indian Gulch	T5N R11E Sec 35 NW 1/4	Placer Gold	Located on the Kraemer channel, this drift was active from 1864 to 1871 and was developed by 75 ft. incine shaft and 3,000 ft. of tunnel, which explored blue pay gravel 6 ft. thick and 60 ft. wide.	Clark and Lydon, 1962, p. 199
244	Jackrabbit mine	T3N R13E Sec 17 SE 1/4	Placer Gold	Located on the Central Hill channel, this mine was active prior to 1899, again in 1903, and last in 1923. Development was by 191 ft. shaft and 1,700 ft. of drifts, which explored a pay gravel channel 35 ft. wide and 7 ft. thick that averaged $2 to $10 per yard.	Kerr, 1900, p. 40; Lindgren, 1911, p. 202-203; Logan, 1924, p. 7; Clark and Lydon, 1962, p. 199-200
245	Johnson	T4N R12E Sec 27 W 1/2 28E. E 1/2	Placer Gold	Located on the Central Hill channel, this hydraulic mine was active prior to 1904 and works a 100 ft. wide channel trending NW. The schist bedrock is overlain by about 8 ft. of gravel, 20 ft. of rhyolite, 40 ft. of sand and gravel.	Lindgren, 1911, p. 203; Clark and Lydon, 1962, p. 200
246	Jupitar (San Domingo)	T3N R13E Sec 7 SE 1/4 17E NW 1/4	Placer Gold	This hydraulic mine, located on the Central Hill channel, worked a 100 ft. bank from 1880 to 1908 with a total of about 300,000 yds. of gravel. The mine was inactive until 1934-1936 when a 600 ft. adit was driven N70°E. This adit explored the top 2 ft. of slate and schist that lay beneath the channel gravels.	Lindgren, 1911, p. 203; Logan, 1936, p. 350; Clark and Lydon, 1962, p. 88-90, 200
247	Kentucky	T3N R13E Sec 26 NE 1/4	Placer Gold	Located on the Central Hill channel, this drift mine was active prior to 1899, when 500 ft. and 1,400 ft. adits were driven in gravels. Prospected just prior to World War II, it was reported that Golden River Mining Co. was ready to open mine in 1941.	Kerr, 1900, p. 40; Clark and Lydon, 1962, p. 200
248	Last Chance	T4N R11E Sec 2 SW 1/4	Placer Gold	Located on the Deep Blue Lead, this drift mine was developed by a 175 and 50 ft. adit prior to 1892. The mine explores gravel capped by soil in a channel trending N40°W.	Kerr, 1900, p. 40; Clark and Lydon, 1962, p. 201

APPENDIX A - MINES AND PROSPECTS OF THE SAN ANDREAS QUADRANGLE

MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
249	Lloyd	T4N R11E Sec 2 SE 1/4 11E NE 1/4	Placer Gold	Located on the Central Hill channel, the Lloyd drift mine was developed by a 800 ft. adit, a 300 ft. incined adit, a 44 ft. vertical shaft, and over 1,000 ft. of drift. This mine, which operated prior to 1873, in the early 1900's and during 1932-1939, follows a 70 ft. channel that has 8 ft. of pay gravel consisting of schist, slate, and quartz that rests above slate of the Calaveras Formation. In 1934 some 12,000 tons of gravel yielded 802 ounces of gold and 124 ounces of silver. During the 1930's 1 1/2 ft. of bedrock and 5 ft. of gravel were mined (Clark, 1962).	Tucker, 1915, p. 119; Logan, 1936, p. 346-347; Julihn, 1938, p. 61-63; Clark and Lydon, 1962, p. 90, 201
250	Merrimac (Central Hill Group)	T4N R11E Sec 11 NW 1/4	Placer Gold	Located on the Deep Blue Lead and Kraemer channel, this drift mine was active in 1866-1867 and in 1899-1901 and is developed by a 75 ft. shaft. The mine is reported to have yielded 108 ozs. of gold in six days in 1866.	Kerr, 1900, p. 42; Clark and Lydon, 1962, p. 202
251	North Star	T3N R13E Sec 21 S 1/2 28E NW 1/4	Placer Gold	Located on the Deep Blue Lead, this drift and hydraulic mine was active prior to 1883 and worked until 1914. The mine was developed by 530 ft., 620 ft., 2,100 ft., and 2,800 ft. tunnels that contain over one mile of workings. It operated as a hydraulic mine in 1894 mining two channels one above the other. Pay gravels up to 13 ft. deep, which rest on weathered granitics and slate, were worked that reported an average value of $1.50 to $2.50 per ton.	Lindgren, 1911, p. 206-207; Tucker, 1915, p. 120; Clark and Lydon, 1962, p. 203
252	Ozark	T3N R13E Sec 23 SW 1/4	Placer Gold	Located on the Central Hill channel, this drift mine operated prior to 1900, in 1916, and again in 1922.	Kerr, 1900, p. 42; Clark and Lydon, 1962, p. 204
253	Quartz Hill	T3N R13E Sec 23 W 1/2	Placer Gold	This placer was worked in 1941 by power shovel and stationary washer and yielded 298 oz. of gold and 30 ozs. of silver from 11,270 yds. of gravel.	Clark and Lydon, 1962, p. 205
254	Railroad Hill	T3N R12E Sec 2	Placer Gold	Located on the Fort Mountain channel, this hydraulic mine was active from 1895 to 1904 and hydrauliced about 20,000 yds. of gravel.	
255	Richie Hill	T4N R12E Sec 26 SE 1/4	Placer Gold	Located on the Fort Mountain channel, this hydraulic mine washed gravel from a 20 ft. high by 200 ft. long bank into sluices.	Clark and Lydon, 1962, p. 205
256	Rising Star	T4N R11E Sec 2 NE 1/4	Placer Gold	Located on the Deep Blue Lead, this drift mine operated intermittently from 1871 to 1939 and is reported to have produced 160 ozs. per month in 1875. Development consist of two main shafts and over 3,000 ft. of drifts, which mine four separate channels in the Deep Blue Lead that average approximately 100 ft. wide and 30 ft. deep. The gravel in these channels consists of a heavy wash of blue clay, large boulders, and cobbles that rest on a bedrock of slate, schist and gabbro. The upper 2 ft. of bedrock and the lower 3 ft. of gravel, which contain medium to coarse gold with considerable amounts of black sand and pyrite, are treated in a trommel and about 70 ft. of sluices.	Tucker, 1915, p. 121; Loagan, 1936, p. 334-335; Julihn, 1938, p. 64-65; Clark and Lydon, 1962, p. 90-91, 205

APPENDIX A - MINES AND PROSPECTS OF THE SAN ANDREAS QUADRANGLE

MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
257	Rose Hill	T4N R13E Sec 8 NE 1/4	Placer Gold	Located on the El Dorado channel, this hydraulic mine operated during 1899 thorugh the early 1900's and in 1953 a short drift was driven. Two monitors washed 214,000 yds. of gravel from a 100 ft. to 150 ft. wide channel that trends N75°E. The pay gravel consists of the bottom 8 ft. of cemented auriferous gravel.	Kerr, 1900, p. 42; Lindgren, 1911, p. 211-212; Tucker, 1915, p. 117; Clark, 1954, p. 17, 21; Clark and Lydon, 1962, p. 205
258	Shaw (Durea)	T4N R11E Sec 11 NE 1/4	Placer Gold	The Shaw mine was first worked from 1866 to 1871 as a hydraulic mine and then when overburden became a problem the operators began drifting from 1871 to 1876. The hydraulic mine washed a 160 ft. high bank, which contained a 160 ft. wide by 30 ft. high channel of rounded quartz gravel. It is reported that the hydraulic mine produced $500,000 of gold (Clark, 1962). Over 3,000 ft. of drifts are contained within the underground workings.	Lindgren, 1911, p. 210; Tucker, 1915, p. 117; Clark and Lydon, 1962, p. 87, 195
259	South Fork	T4N R12E Sec 30	Placer Gold	This drift mine operated in the 1920's and again from 1936 to 1937 with an average value of $3.50 per yd. (Clark, 1962). This mine is developed by 382 ft. of shafts and drifts as well as with the use of a gasoline shovel. Three gravel benches about 10 ft. thick and 400 ft. wide were mined.	Logan, 1936, p. 351; Julihn, 1938, p. 92-93; Clark and Lydon, 1962, p. 206
260	Table Mountain	T4N R13E Sec 14 NW 1/4	Placer Gold	Located on the El Dorado channel, this hydraulic mine, which worked in 1914, washed a gravel channel 1,000 ft. wide by 20 ft. thick that is reported to average $.25 per yd. (Clark, 1962).	Tucker, 1915, p. 122; Clark and Lydon, 1962, p. 207
261	Union Shaft	T4N R11E Sec 11 NE 1/4	Placer Gold	Located on the Central Hill and Deep Blue Lead, this drift mine operated from 1869 to 1914 with the last reported production being 72 1/2 ozs. in 1890. The mine was developed by a 100 ft. shaft and a 150 ft. shaft with a 1,200 ft. north trending drift.	Lindgren, 1911, p. 209; Tucker, 1915, p. 122; Clark and Lydon, 1962, p. 208
262	Vallecito Western	T3N R13E Sec 24 SW 1/4	Placer Gold	Located on a 275 ft. wide Tertiary channel, this drift mine was developed from 1924 to 1941 by 167 ft. vertical shaft and over 6,300 ft. of drifts and crosscuts. The pay gravels range from 40 to 150 ft. in width and approximately 6 ft. thick. It is reported that by 1936 this mine had yielded 11,428 ozs. of gold and 815 ozs. of silver from about 41,000 tons of gravel.	Logan, 1924, p. 6-7; Logan, 1925, p. 161; Logan, 1936, p. 353-355; Julihn, 1938, p. 38-42; Clark and Lydon, 1962, p. 92-93, 208
263	Val Ranch	T3N R13E Sec 23 SW 1/4	Placer Gold	Located on the Central Hill channel, this drift mine was developed prior to 1915 through a 60 ft. shaft.	Tucker, 1915, p. 121; Clark and Lydon, 1962, p. 208
264	Worth's Hell	T4N R11E Sec 2 NE 1/4	Placer Gold	This drift and hydraulic mine operated in the 1860's as a drift mine and from 1873 to 1874 as a hydraulic mine. The mine worked a 90 ft. bed of gravel, which consists of poorly sorted metamorphic pebbles and cobbles.	Clark and Lydon, 1962, p. 209
265	Ponderosa	T3N R13E Sec 2 NE 1/4	Iron	This prospect was developed by open pit and explores massive magnetite in thin layers in antigorite.	Clark, 1954, p. 21; Clark and Lydon, 1962, p. 210

APPENDIX A - MINES AND PROSPECTS OF THE SAN ANDREAS QUADRANGLE

MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
266	Airola	T3N R13E Sec 35 SW 1/4	Manganese	This mine was active during World War II and was developed by open pits. The mineralization consists of manganese oxide in northwest striking metachert lenses in phyllite and schist.	Trask, 1943, p. 72, 106; Trask, 1950, p. 38-40; Clark and Lydon, 1962, p. 211
267	Big Little Bear	T3N R11E Sec 11 SW 1/4	Manganese	This prospect was developed by open pits in the Copper Hill volcanics. The mineralization consists of psilomelane lenses up to 1 ft. in thickness. The ore zone is up to 4 ft. thick and 150 ft. long and strikes N40°W and dips 55°NE.	Trask, 1943, p. 76, 106; Trask, 1950, p. 38-40; Clark and Lydon, 1962, p. 211
268	Fortner Ranch	T4N R12E Sec 4 SW 1/4	Manganese	The development of this manganese mine is by four pits, the largest is 6 ft. x 6 ft. x 6 ft., and all of this work was during World War I. The ore consists of partly oxidized N40°-55°W striking vertical dipping beds of spessartine in quartz and quartzite.	Logan, 1925, p. 163; Trask, 1943, p. 76, 106; Trask, 1950, p. 42-43; Clark and Lydon, 1962, p. 212
269	Kellogg	T2N R12E Sec 4 S 1/2	Manganese	This mine was developed by open cuts during World War I in chert and phyllite. The mineralization consists of a bed of manganese oxide 1 to 6 ft. thick, which strikes N30°-35°W and dips 70°NE-45°SW.	Logan, 1925, p. 163; Trask, 1943, p. 76, 107; Trask, 1950, p. 45-46; Clark and Lydon, 1962, p. 212
270	Lavagnino	T2N R13E Sec 4 NE 1/4	Manganese	This mine was developed by a 10 ft. x 6 ft. and 3 ft. deep open pit in gray phyllite and slate, which contains psilomelane some fairly high-grade (48 percent) samples (Trask, 1950).	Trask, 1943, p. 107; Trask, 1950, p. 46; Clark and Lydon, 1962, p. 212
271	Turner and Loyd	T2N R12E Sec 15	Asbestos	Located in 1953 this asbestos mine has been worked through an adit, open cuts, and open pits and a small stockpile left on the property. The ore consists of chrysotile asbestos in stockworks of small corss-fiber seams and veins. The host rock is light green massive serpentine.	Logan, 1925, p. 164; Logan, 1936, p. 227; Clark and Lydon, 1962, p. 20-21
272	Calaveras Cement	T4N R12E Sec 29 N 1/2	Limestone	First worked in 1922, production from this mine continued until the 1970's. The deposit consists of two lenses of high-calcium limestone about 2,000 ft. long and 500 ft. wide striking N30°-45°W and dipping NE75°NE. Between the two lenses are small bodies of high-grade limestone interbedded with beds of sheared hydrothermally altered dolomite which locally contains magnesite.	Logan, 1925, p. 165, 167; Logan, 1936, p. 232-233; Logan, 1947, p. 216-217; Bowen, 1948, p. 58-60; Bowen, 1949, p. 38-39; Clark, 1954, p. 14-19; Clark and Lydon, 1962, p. 97-102, 210
273	Calaveritas-Esmeralda	T4N R13E Sec 30 SW 1/4	Limestone	This deposit consists of a number of westtrending limestone lenses that are interbedded with meta- sedimentary rocks of the Calaveras Formation. The large (800 ft. x 1,200 ft.) western body has been mined since 1957 by Calaveras Cement. Generally, the larger lenses in this area contain high-calcium limestone, and the smaller ones are largely dolomitic (Willard Fuller, personal communication). The limestone is massive and coarsely crystalline, and ranges from white to gray in color. The nearby country rock (shale) is mined for the necessary silica, alumina, and ferric oxide required to make cement. This deposit has a number of small interbeds of schist which are mined along with the limestone and supply part of the needed shale for cement making.	Logan, 1936, p. 227, p. 232-233; Logan, 1947, p. 216-217; Clark, 1954, p. 14-15, p. 18-19; Clark and Lydon, 1962, p. 102, 210

APPENDIX A - MINES AND PROSPECTS OF THE SAN ANDREAS QUADRANGLE

MAP NO.	NAME	LOCATION	COMMODITIES	COMMENTS	SELECTED REFERENCES
274	Cave City	T4N R13E Sec 3, 4, 10, 11, 14	Limestone	This large deposit is four miles long and ranges from 600 ft. to 1,500 ft. in thickness. It is lensord in shape, the lens striking N45°W and dipping 60°-75°NE. The country rock is graphitic schist and impure quart- zite of the Calaveras Formation, which also occurs as small interbeds. The limestone is white to bluish-gray in color and is brecciated and recemented. The prominent outcrops are usually dolomitic (Clark, 1954). The composition of the limestone ranges from low-magnesian limestone to dolomite.	Turner, 1894, p. 3; Logan, 1925, p. 167; Logan, 1947, p. 217; Clark, 1954, p. 17; Clark and Lydon, 1962, p. 102, 210
275	Kentucky House	T4N R12E Sec 29, 32	Limestone	A series of north to northwest-striking limestone and dolomite lenses extends from 1 mile north of the Calaveras Cement Co. plant southward for a distance of 4 miles. Kentucky House deposit itself consists of 1 1/2 mile long and nearly 1,400 ft. thick series of en echelon lenses of high-calcium limestone. These lenses range from 1/2 to 3/4 of a mile long and 300 ft. to 500 ft. in thickness. The dolomite, which includes some crystalline magnesite, contains 40 percent or more magnesium carbonate.	Logan, 1925, p. 165; Logan, 1936, p. 227, p. 232-233; Logan, 1947, p. 216-217; Clark and Lydon, 1962, p. 104, 210
276	Iron Rock	T2N R13E Sec 14 E 1/2	Silica	Located in the Mother Lode belt, this deposit consists of a massive quartz vein, which was mined in 1925 and used as a steel flux.	Logan, 1925, p. 170; Clark and Lydon, 1962, p. 213
277	Caldwell	T4N R11E Sec 35 NW 1/4	Stone	This small pit has worked intermittently since before 1906. The quarry explores a small east-trenching lens of dark, mottled marble that takes a high polish.	Crawford, 1896, p. 627; Aubury, 1906, p. 98-99; Logan, 1947, p. 219; Clark and Lydon, 1962, p. 213
278	Ghost	T3N R13E Sec 34	Stone	This quarry operated in 1920. They crushed slabby, massiv e greenstone and shipped it to Richmond for use on roofing paper. Some of the dump material has also been used for road base.	Logan, 1921, p. 424; Clark and Lydon, 1962, p. 214
279	Hertzig	T4N R12E Sec 32 E 1/4	Stone	This quarry is probably the same as Calaveras Cement Co's #2 quarry. There is no information regarding the production from this quarry, but it is reported to be a compact gray marble (Clark, 1962).	Aubury, 1906, p. 99; Logan, 1947, p. 219; Clark and Lydon, 1962, p. 214
280	Peirano Quarry	T3N R13E Sec 27 NW 1/4	Stone	First operated in the 1850's, this quarry has been active intermittently and mines a tough, massive, fine-grained, grayish-white rhyolitic tuff. The quarry, which is about 50 ft. long by 25 ft. wide by 15 ft. deep, mines only the top 20 ft. of tuff for use in the manufacture of pink concrete blocks and as road gravel, decorative gravel, and terrazzo.	Chesterman, 1956, p. 36; Clark and Lydon, 1962, p. 120, 215
281	Treat	T4N R12E Sec 16 NE 1/4	Stone	A small quarry mines a small lens of white and variegated, fine-grained marble that was used in the construction of county buildings about 1906.	Aubury, 1906, p. 99; Logan, 1947, p. 219; Clark and Lydon, 1962, p. 216
282	Tryon	T2N R13E Sec 3 NW 1/4	Stone	Active prior to 1925 until 1941, the Tryon mine mines fresh, massive, slabby greenstone (green amphibolite schist), which is crushed and used as stucco dash, roofing rock, and roofing granules.	Logan, 1925, p. 168-169; Logan, 1936, p. 235; Clark and Lydon, 1962, p. 216

APPENDIX A - MINES AND PROSPECTS OF THE SAN ANDREAS QUADRANGLE

MAP NO.	NAME	LOCATION		COMMODITIES	COMMENTS	SELECTED REFERENCES
283	Western Source	T2N Sec 1	R13E SW 1/4	Talc	This open pit mines four benches for talc. The mineralization consists of a 40 ft. talc bed that has formed by the hydrothermal alteration of a quartz mica schist. The talc strikes N27°W and dips 55°NE and is exposed for over 200 ft. in length. The talc contains occasional iron streaks and rock fragments.	
284	Unnamed Talc	T2N Sec 1	R13E NW 1/4	Talc	This adit explores a 25 ft. zone consisting 1 1/2 to 2 ft. thick beds of talc that strike N10°W-70°NE and contains quartz veinlets and minor amounts of copper oxides and pyrite. These beds are within talc-chlorite schist.	
285	Unnamed Talc	T3N Sec 7	R13E NE 1/4	Talc	This property has a shaft and adit that explores a brecciated talc schist, which contains talc, calcite, quartz, mariposite, and kaolin along a 3 ft. zone that trends eastwest and dips 80°S.	
286	Madrid	T3N Sec 2	R13E SW 1/4	Chromite	The Madrid mine was worked from 1916 to 1918 by John Madrid and 982 long tons of chromite were produced (Cater, 1948, p. 57). It lay idle until 1942-1943 when the present owner mined 57 long tons of chrome ore. The mine has been idle since 1943. The ore body is an irregular, broken lens of nearly massive and disseminated chromite that strikes N80°W and dips 65°SW. The maximum thickness of the lens is 12 ft., but its length is not known. Country rock consists of schistose altered serpentine. Chromic oxide content of the ore shipped was about 30 percent (Cater, 1948, p. 57). Workings include an open pit 45 ft. long, 45 ft. wide and 15 ft. deep, and a 25 ft. inclined shaft located in the bottom of the pit.	Bradley, 1918, p. 123; Cater, 1948, p. 56; Clark and Logan, 1962, p. 22

APPENDIX B

MINERAL RESOURCE/RESERVE CLASSIFICATION

APPENDIX B

MINERAL RESOURCE/RESERVE CLASSIFICATION

Nomenclature

Following are definitions of the nomenclature associated with the California Mineral Land Classification diagram. It is important to refer to these definitions when studying the different resource categories shown on Figure 3.

RESOURCE – A concentration of naturally occurring solid, liquid, or gaseous material in and/or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

RESERVES – That part of the reserve base which could be economically extracted or produced at the time of determination. The term *reserves* need not signify that extraction facilities are in place and operative.

Reserves include only recoverable materials; thus, terms such as "extractable reserves" and "recoverable reserves" are redundant and are not a part of this classification.

ORIGINAL RESOURCE – The amount of a resource before production.

IDENTIFIED RESOURCES – Resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. *Identified resources* include economic, marginally economic, and subeconomic components. To reflect varying degrees of geologic certainty, these economic divisions can be subdivided into *measured*, *indicated*, and *inferred*.

MEASURED RESERVES – Quantity is computed from dimensions revealed in outcrops, trenches, workings, or drill holes; grade and/or quality are computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, depth, and mineral content of the resource are well established.

INDICATED RESERVES – Quantity and grade and/or quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling, and measurement are farther apart or otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume continuity between points of observation.

DEMONSTRATED RESERVES – A term for the sum of *Measured* plus indicated *reserves*.

INFERRED RESOURCES – Estimates are based on an assumed continuity beyond measured and/or indicated resources, for which there is geologic evidence. *Inferred resources* may or may not be supported by samples or measurements.

MARGINAL RESERVES – That part of the reserve base which, at the time of determination, borders on being economically producible. The essential characteristic here is economic uncertainty. Included are resources that would be producible, given postulated changes in economic or technologic factors.

ECONOMIC – This term implies that profitable extraction or production under defined investment assumptions has been established, analytically demonstrated, or assumed with reasonable certainty.

SUBECONOMIC RESOURCES – The part of identified resources that does not meet the economic criteria of reserves and marginal reserves.

UNDISCOVERED RESOURCES – Resources, the existence of which are only postulated, comprising deposits that are separate from identified resources. *Undiscovered resources* may be postulated in deposits of such grade and physical location as to render them economic, marginally economic, or subeconomic. To reflect varying degrees of geologic certainty, undiscovered resources may be divided into two parts:

HYPOTHETICAL RESOURCES – Undiscovered resources that are similar to known mineral bodies and that may be reasonably expected to exist in the same producing district or region under analogous geologic conditions. If exploration confirms their existence and reveals enough information about their quality, grade, and quantity, they will be reclassified as identified resource.

SPECULATIVE RESOURCES – Undiscovered resources that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential. If exploration confirms their existence and reveals enough information about their quantity, grade, and quality, they will be reclassified as identified resources.

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MINERAL LAND CLASSIFICATION OF THE SAN ANDREAS 15-MINUTE QUADRANGLE, CALAVERAS COUNTY, CALIFORNIA

SPECIAL REPORT 169

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SPECIAL REPORT 169
GENERALIZED GEOLOGY OF THE SAN ANDREAS 15-MINUTE QUADRANGLE
PLATE 1

CENOZOIC — QUATERNARY / TERTIARY
MESOZOIC — CRETACEOUS / JURASSIC
PALEOZOIC

SEDIMENTARY/METASEDIMENTARY ROCKS

T — Oradga Tailings

Qal — Quaternary Alluvium

Tm — Mahrlen Formation – Stream channel, alluvial and mudflow deposits derivad mainly from andasitic volcanic locks.

Tvs — Valley Springs Formation – Stream channel and alluvial deposits derived mainly from rhyolitic volcanic rocks. Also includas white weldad tuff and ash flows.

Tg — Tertiary river channel deposits – mainly sand and gravel.

Jmb / Jm / Jlr / Jch / Jss / Jgo / Js / Jv — Mesozoic Volcanic Island Arc Terlene

Jm — Mariposa Formation – dark gray slate with subordinate tuff, graywacke, and conglomerate. Jmb – Brower Creek member predominantly dark green mafic volcanic breccia.

Jlr — Logtown Ridge Formation – coarse mafic volcanic breccia, in part porphyritic (augite phenocrysts). Subordinate tuff and lapilli tuff, minor pillow lava.

Jch — Copper Hill Volcanics – mostly mafic to andesitic pyroclastic rocks, lava, and pillow lava with subordinate felsic porphyritic and pyroclastic rocks.

Jss — Salt Springs Slate – mostly dark gray slate with subordinate tuff, graywacke, and rare conglomerate.

Jgo — Gopher Ridge Volcanics – mostly mafic to andesitic pyroclastic rocks, lava, and pillow lava with subordinate felsic porphyritic and pyroclastic rocks.

Js — Predominately phyllite and phyllitic sandstone, contains volcanoclastic sandstone of graywacke and cherl – volcanic pebble conglomerate

Jv — Andesitic greenschist facies rocks-principally augitic and plagioclase bearing tuff breccias

ms / mv / gb / um — Foothill Melange–Ophiolite Tarrana

ms – Metasedimentary Rocks–Slate, quartzite, chert, carbonate rocks.

mv – Metavolcanic Rocks–Mafic to felsic; minor sedimentary rocks.

gb – Gabbroic and Hypabyssal intrusive Rocks.

um – Ultramafic Rocks–Partly to completely serpentinized ultramafic rocks; locally includes gabbroic and plagiogranitic rocks.

Pzcc / Is / Pzcl / Pzcv — Calaveras Complex

Pzcc – Chert, argillite, slate.

Pzcl – Talc-bearing schist

Pzcv – Andesite, tuff, breccia, basalt flows.

Is – Crystalline limestone and dolomite.

Pzsf — Shoo Fly Complex

Highly deformed early to middle Paleozoic miogeoclinal deposits composed predominantly of quartzofeldspathic schist and gneiss; quartz-mica schist, and phyllite.

INTRUSIVE ROCKS

Tvd — Dacite Plug – Gray and brown fragmental porphyritic hornblende-biotite dacite (Rose, 1959, p.14). Exposed only at Golden Gate Bridge

Mzg / Mzd — Felsic Plutonic Rocks – Igneous rocks variable in texture and composition, particularly near their margins, where they locally grade into more mafic rocks.

Mzg – granodioritic rocks
Mzd – diaritic rocks

PzMz / Is — Rocks within the Melones Fault Zone

Highly sheared and recrystallized metamorphic rocks including phyllitic and phyllonitic greenstone and amphibolite, hornblende metagabbro, hornblende mylonite, and blastite, with small to massive blocks of carbonate rocks (Is).

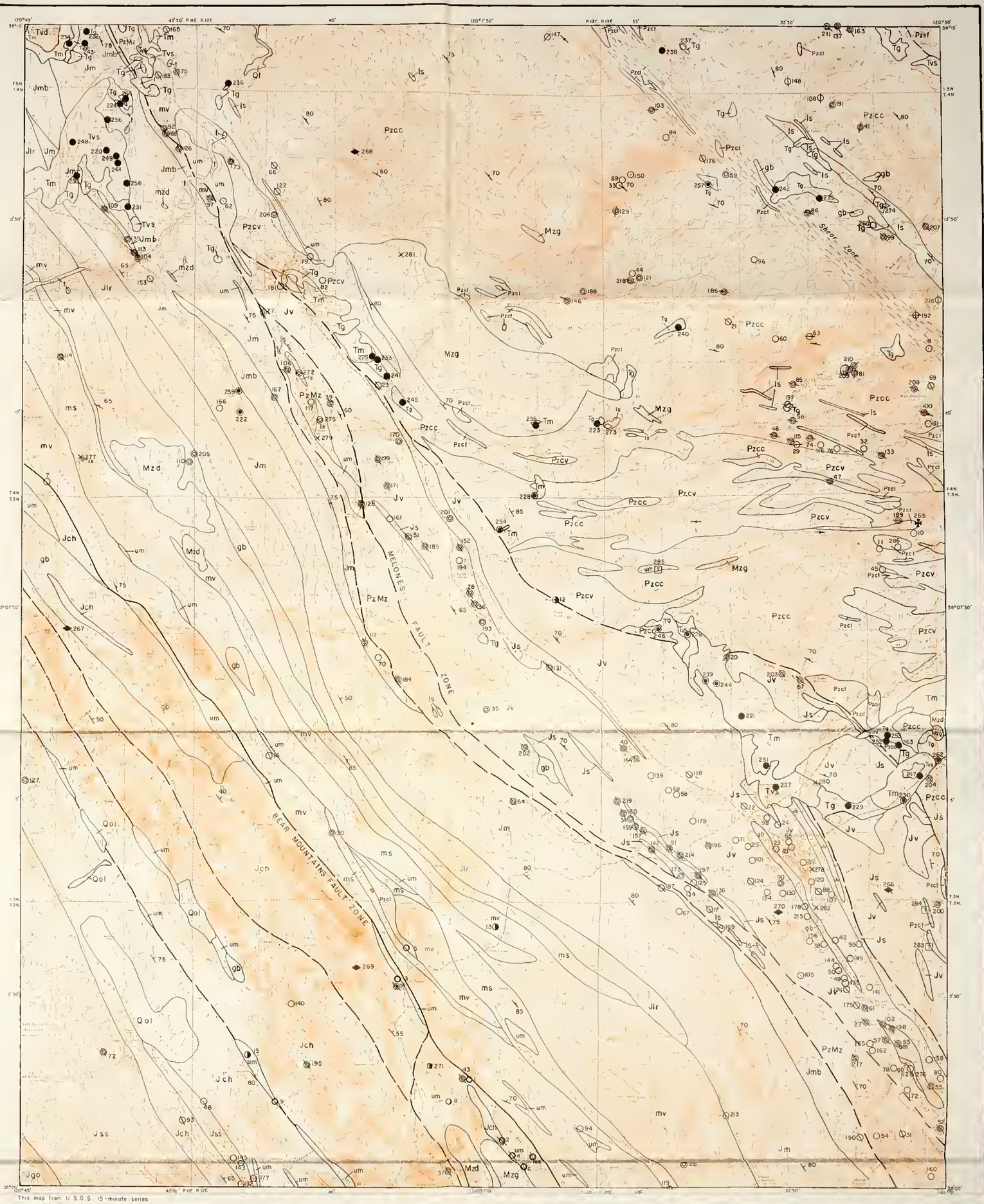
EXPLANATION

Geologic contact, dashed where inferred

MINERAL SYMBOLS

METALLIC
- Copper
- Gold, Lode
- Gold, Placer

NON METALLIC
- Asbestos
- Carbonate Rock
- Talc



This map from U.S.G.S. 15-minute series increased to the scale of 1:48,000.

GEOLOGIC INDEX MAP

Fault, dashed where inferred

Shear zones

Strike and dip of foliation

Mine and prospect location

Gold, Placer

Manganese

Chromite

Iron

Talc

Silica

Index Number

Trend of Deposit

GENERAL GEOLOGY OF THE SAN ANDREAS 15-MINUTE QUADRANGLE

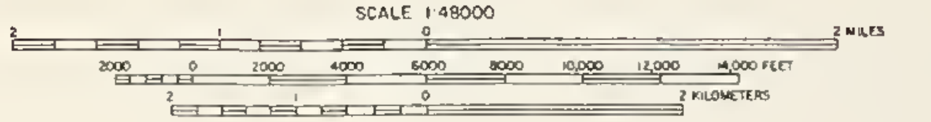
CALAVERAS COUNTY, CALIFORNIA

by

R.B.Greenwood and S.E.Joseph

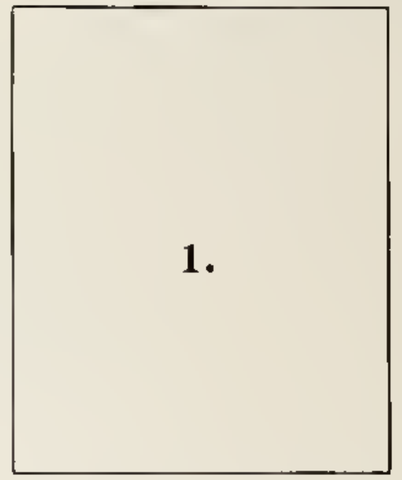
1989

SCALE 1:48000



DECLINATION

GEOLOGIC INDEX MAP



1. Clark, L.D., Stromquist, A.A., Tatlock, D.B., 1963. Geologic Map of the San Andreas Quadrangle, Calaveras County, California: U.S. Geologic Survey, GQ-222.

MINES AND PRDSPECTS OF THE SAN ANDREAS QUADRANGLE

MAP NO.	NAME	MINERAL RESOURCE ZONE LOCATION	COMMODITIES
[illegible]	[illegible]	[illegible]	[illegible]

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plate 2
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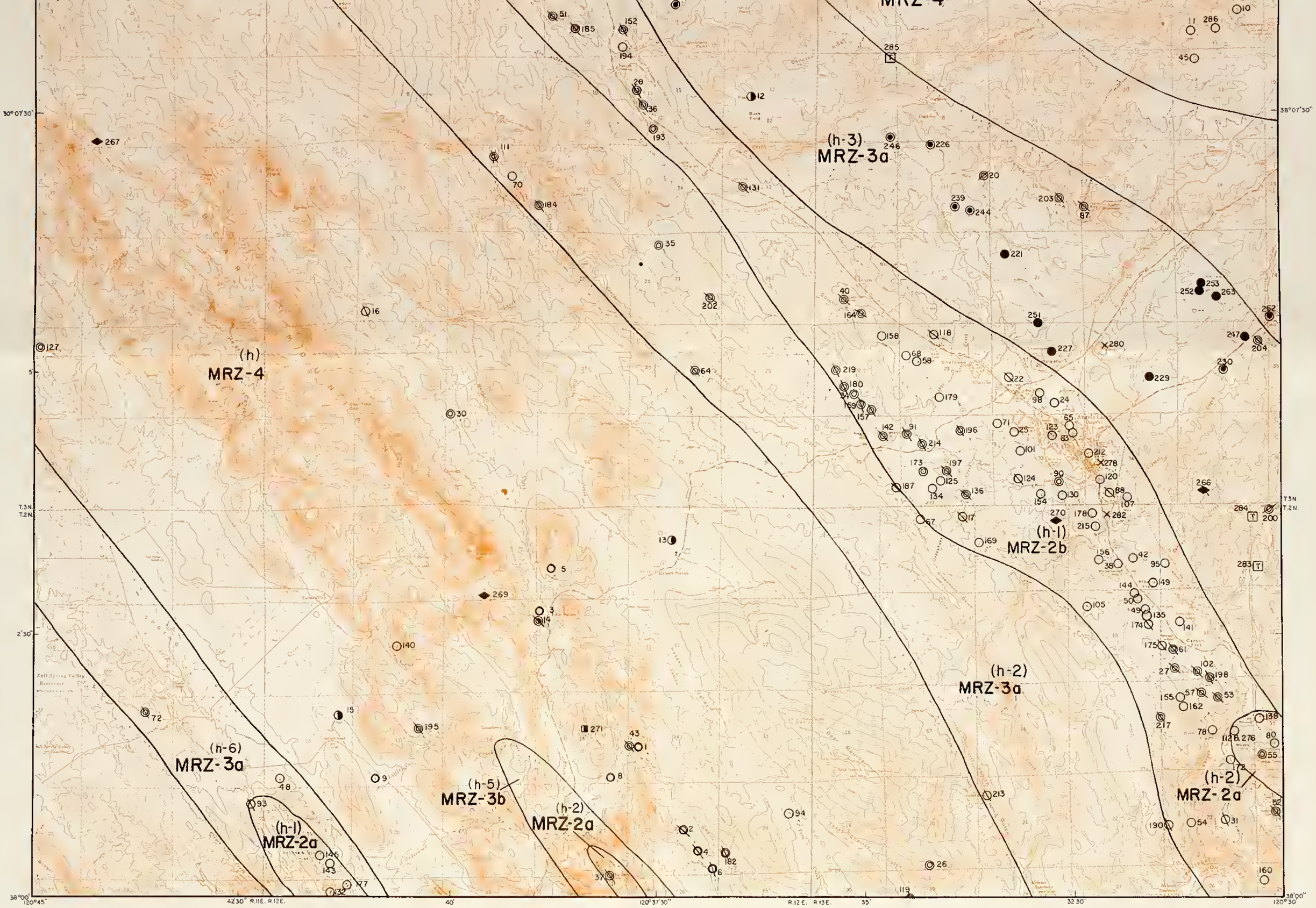
SPECIAL REPORT 169

MINERAL LAND CLASSIFICATION MAP - DEPOSITS FORMED BY HYDROTHERMAL PROCESSES

PLATE 2

MRZ-4 (h)
MRZ-3a (h-4)
MRZ-2b (h-1)
MRZ-3a (h-2)
MRZ-4 (h)
MRZ-3a (h-3)
MRZ-4 (h)
MRZ-3a (h-4)
MRZ-4 (h)
MRZ-2b (h-1)
MRZ-3a (h-2)
MRZ-4 (h)



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MINERAL LAND CLASSIFICATION MAP

SAN ANDREAS 15-MINUTE QUADRANGLE

by

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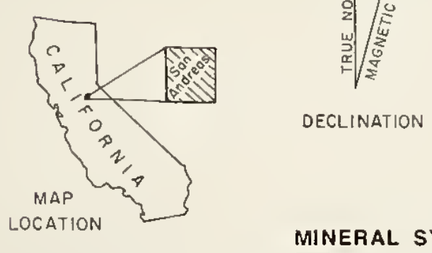
1989



DECLINATION

SCALE 1:48000

2 1 0 2 MILES

2000 0 2000 4000 6000 8000 10,000 12,000 14,000 FEET

2 1 0 2 KILOMETERS

MINERAL SYMBOLS

METALLIC	NON METALLIC
Copper	[A] Asbestos
Gold, Lode	[L] Carbonate Rock
Gold, Placer	[T] Talc
Manganese	(S) Silica
Chromite	
Iron	

Index Number (See Plate 1)

Trend of Deposit

MRZ-4 Mineral Resource Zone Boundaries. See mineral land classification criteria for resource zone (MRZ) definitions.

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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Deposits Formed by Hydrothermal Processes

MRZ-1(hl): Areas where geologic information indicates there is little likelihood that hydrothermal mineral deposits of significance are present.

MRZ-2a(hl): Areas containing hydrothermal ore deposits where geologic data indicates significant measured or indicated reserves are present.

MRZ-2b(hl): Areas containing hydrothermal ore deposits where geologic information indicates that significant inferred resources are present.

MRZ-3a(hl): Areas underlain by geologic terranes within which undiscovered metallic deposits similar to known hydrothermal deposits in the same producing district or region may be reasonably expected to exist (hypothetical resources). Such areas may include prospects of undetermined significance.

MRZ-3b(hl): Areas that may contain undiscovered metallic resources of hydrotherami origin that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their mineral potential (speculative resources).

MRZ-4(hl): Areas where available information does not rule out the presence or absence of hydrothermal mineral deposits.

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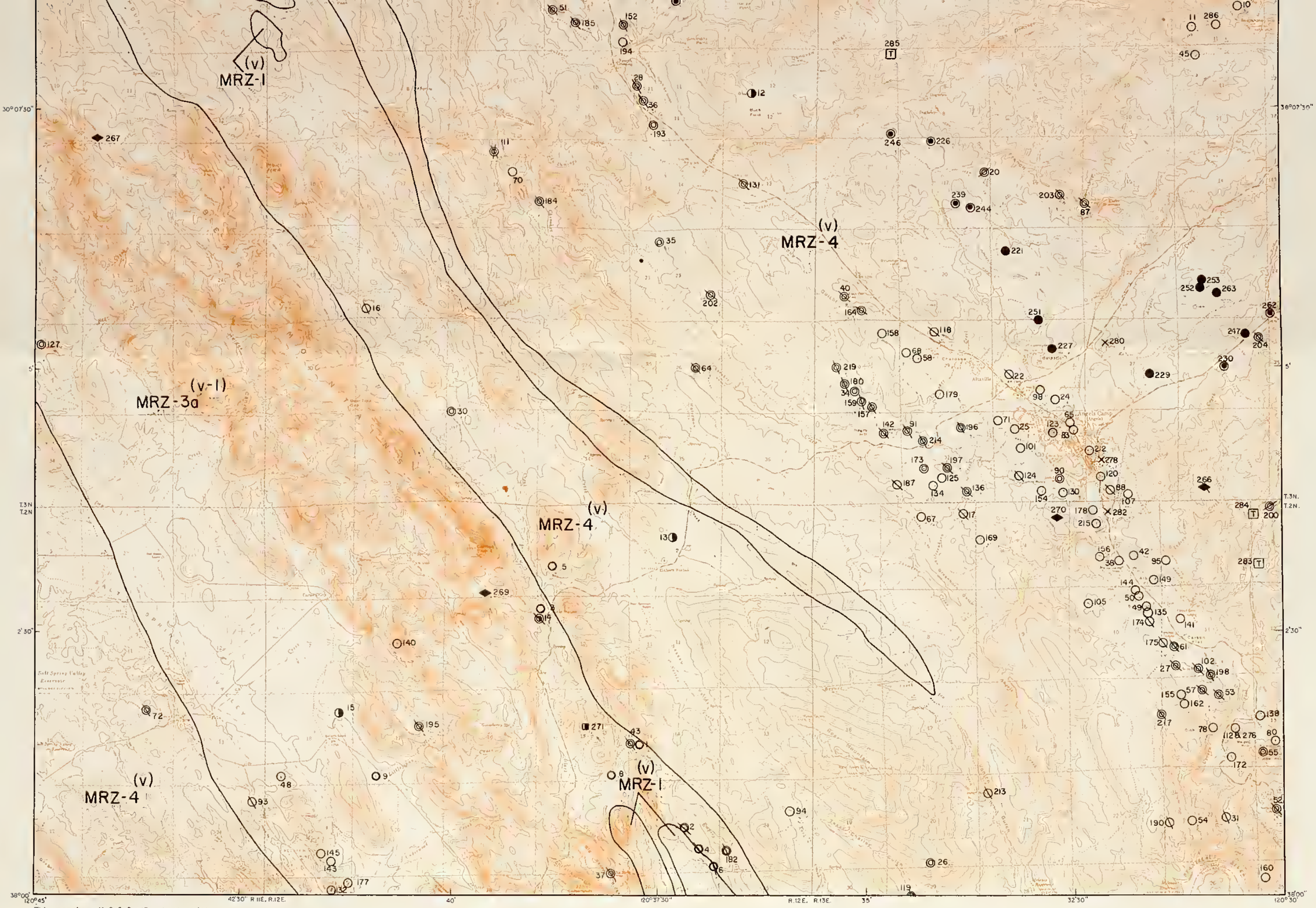
MINERAL LAND CLASSIFICATION MAP - DEPOSITS FORMED BY VOLCANOGENIC PROCESSES

PLATE 3



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MINERAL LAND CLASSIFICATION MAP

SAN ANDREAS 15-MINUTE QUADRANGLE

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SCALE 1:48000

2 1 0 2 MILES

2000 0 2000 4000 6000 8000 10,000 12,000 14,000 FEET

2 1 0 2 KILOMETERS

MINERAL SYMBOLS

METALLIC	NON METALLIC
◑ Copper	[A] Asbestos
○ Gold, Lode	[L] Carbonate Rock
● Gold, Placer	[T] Talc
◆ Manganese	[S] Silica
⬡ Chromite	
✠ Iron	

◑[6] Index Number (See Plate 1)

⊘ Trend of Deposit

MRZ-4 Mineral Resource Zone Boundaries. See mineral land classification criteria for resource zone (MRZ) definitions.

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

ACTING STATE GEOLOGIST

Deposits Formed by Volcanogenic Processes

MRZ-1[v]: Areas where geologic information indicates there is little likihood for the presence of significant volcanogenic metallic ore deposits. These areas represent geologic terrances within which marine volcanic rocks are not expected to be present at the surface or at reasonable depths.

MRZ-2a[v]: Areas containing metallic ore deposits of volcanogenic origin where geologic data indicate significant measured or indicated resources are present.

MRZ-2b[v]: Areas containing metallic ore deposits of volcanogenic origin where geologic information indicates that significant inferred resources are present.

MRZ-3a[v]: Areas underlain by marine volcanic rock sequences in which undiscovered volcanogenic ore deposits similar to known deposits in the same producing district or region, may be reasonably expected to exist (hypothetical resources). Such areas may include prospects of undetermined significance.

MRZ-3b[v]: Areas that may contain undiscovered volcanogenic base and precious metal resources that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential (speculative resources).

MRZ-4[v]: Areas where geologic information does not rule out either the presence or absence of volcanogenic base and precious metal deposits. These areas represent geologic environments in which unmapped or concealed marine volcanic rocks could occur.

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SPECIAL REPORT 169

MINERAL LAND CLASSIFICATION MAP - INDUSTRIAL MINERAL DEPOSITS

PLATE 4

(i-5) MRZ-3a (carbonate rock)

(i-3) MRZ-3a (talc)

(i-2) MRZ-3a (talc, asbestos)

(i) MRZ-4

(i-3) MRZ-2b (carbonate rock)

(i-1) MRZ-2b (carbonate rock)

(i-3) MRZ-3a (talc, asbestos)

(i-4) MRZ-3a (silica)

(i-2) MRZ-2b (carbonate rock)

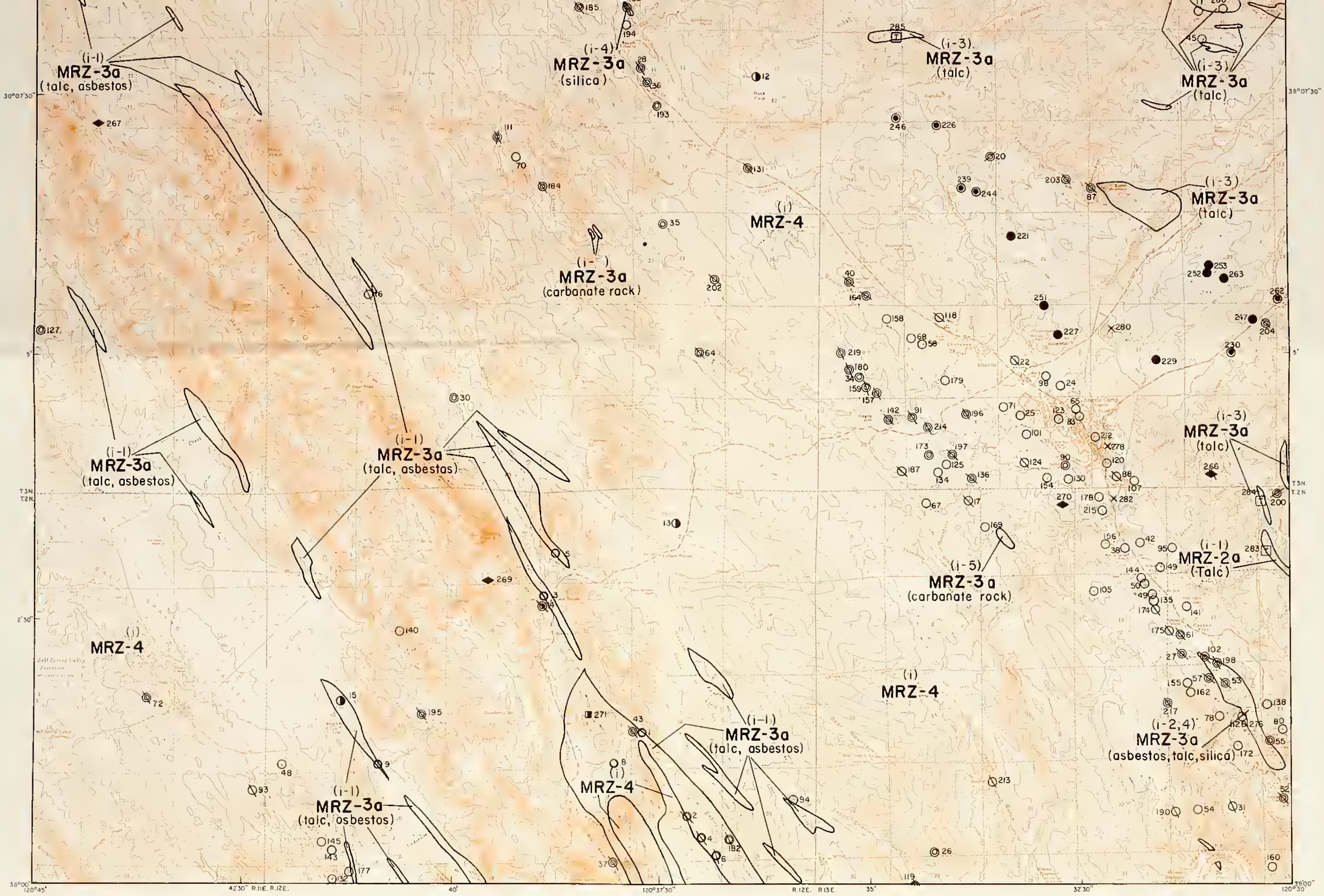
(i-5) MRZ-2b (carbonate rock)

(i-1) MRZ-3a (talc, asbestos)

(i-1) MRZ-2a (Talc)

(i-5) MRZ-3a (carbonate rock)

(i-) MRZ-3a (carbonate rock)



This map from U.S.G.S. 15-minute series increased to the scale of 1:48,000.

MINERAL LAND CLASSIFICATION MAP

SAN ANDREAS 15-MINUTE QUADRANGLE

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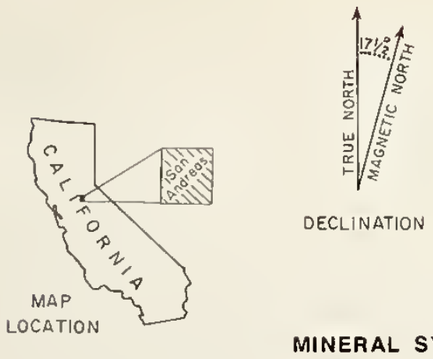

SCALE 1:48000

2 1 0 2 MILES

2000 0 2000 4000 6000 8000 10,000 12,000 14,000 FEET

2 1 0 2 KILOMETERS

MINERAL SYMBOLS

METALLIC	NON METALLIC
Copper	Asbestos
Gold, Lode	Carbonate Rock
Gold, Placer	Talc
Manganese	Silica
Chromite	
Iron	

Index Number (See Plate 1)

Trend of Deposit

MRZ-4 — Mineral Resource Zone Boundaries. See mineral land classification criteria for resource zone (MRZ) definitions.

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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MRZ-1[i]: Areas where available geologic information indicates there is little likelihood for the presence of industrial mineral deposits.

MRZ-2a[ii]: Areas where geologic data indicates that significant measured or indicated industrial mineral resources are present.

MRZ-2b[ii]: Areas underlain by deposits containing industrial minerals where geologic information indicates significant inferred resources of rock suitable for use as a marketable product are present.

MRZ-3a[iii]: Areas underlain by geologic terranes within which undiscovered industrial mineral resources similar to known deposits in the same producing district or region may be reasonably expected to exist (hypothetical resources). Such areas may include prospects of undetermined significance.

MRZ-3b[iii]: Areas that may contain undiscovered industrial mineral resources that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential (speculative resources).

MRZ-4[iii]: Areas where geologic information does not rule out either the presence or absence of industrial mineral resources.

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SPECIAL REPORT 169
MINERAL LAND CLASSIFICATION MAP - DEPOSITS FORMED BY MAGMATIC SEGREGATION
PLATE 5

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MINERAL LAND CLASSIFICATION MAP
SAN ANDREAS 15-MINUTE QUADRANGLE

by
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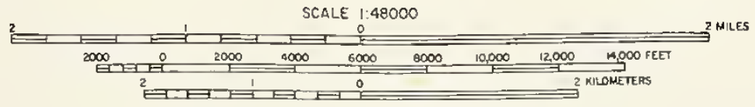

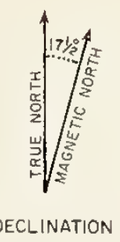

MINERAL SYMBOLS

METALLIC	NON METALLIC
Copper	Asbestos
Gold, Lode	Carbonate Rock
Gold, Placer	Talc
Manganese	Silica
Chromite	
Iron	

Index Number (See Plate 1)

Trend of Deposit

MRZ-4 — Mineral Resource Zone Boundaries. See mineral land classification criteria for resource zone (MRZ) definitions.

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

ACTING STATE GEOLOGIST

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Deposits Formed by Magmatic Concentration

MRZ-1$^{(m)}$: Areas where geologic information indicates there is little likelihood for the occurrence of significant deposits formed by magmatic concentration. These areas represent geologic terranes within which chromite-bearing ultramafic rocks are not expected to be present at the surface or at reasonable depths.

MRZ-2a$^{(m)}$: Areas containing deposits formed by magmatic concentration where geologic data indicates significant measured or indicated resources are present.

MRZ-2b$^{(m)}$: Areas encompassing one or more deposits formed by magmatic concentration where geologic information indicates significant inferred chromite resources are present.

MRZ-3a$^{(m)}$: Areas underlain by intrusive rocks within which undiscovered deposits in the same producing district or region may be reasonably expected to exist (hypothetical resources). Such areas may include prospects of undetermined significance.

MRZ-3b$^{(m)}$: Areas that may contain undiscovered resources formed by magmatic concentration that occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential (speculative resources).

MRZ-4$^{(m)}$: Areas where geologic information does not rule out either the presence or absence of chromite resources. These areas represent geologic environments in which unmapped or concealed chromite-bearing ultramafic rocks could occur.

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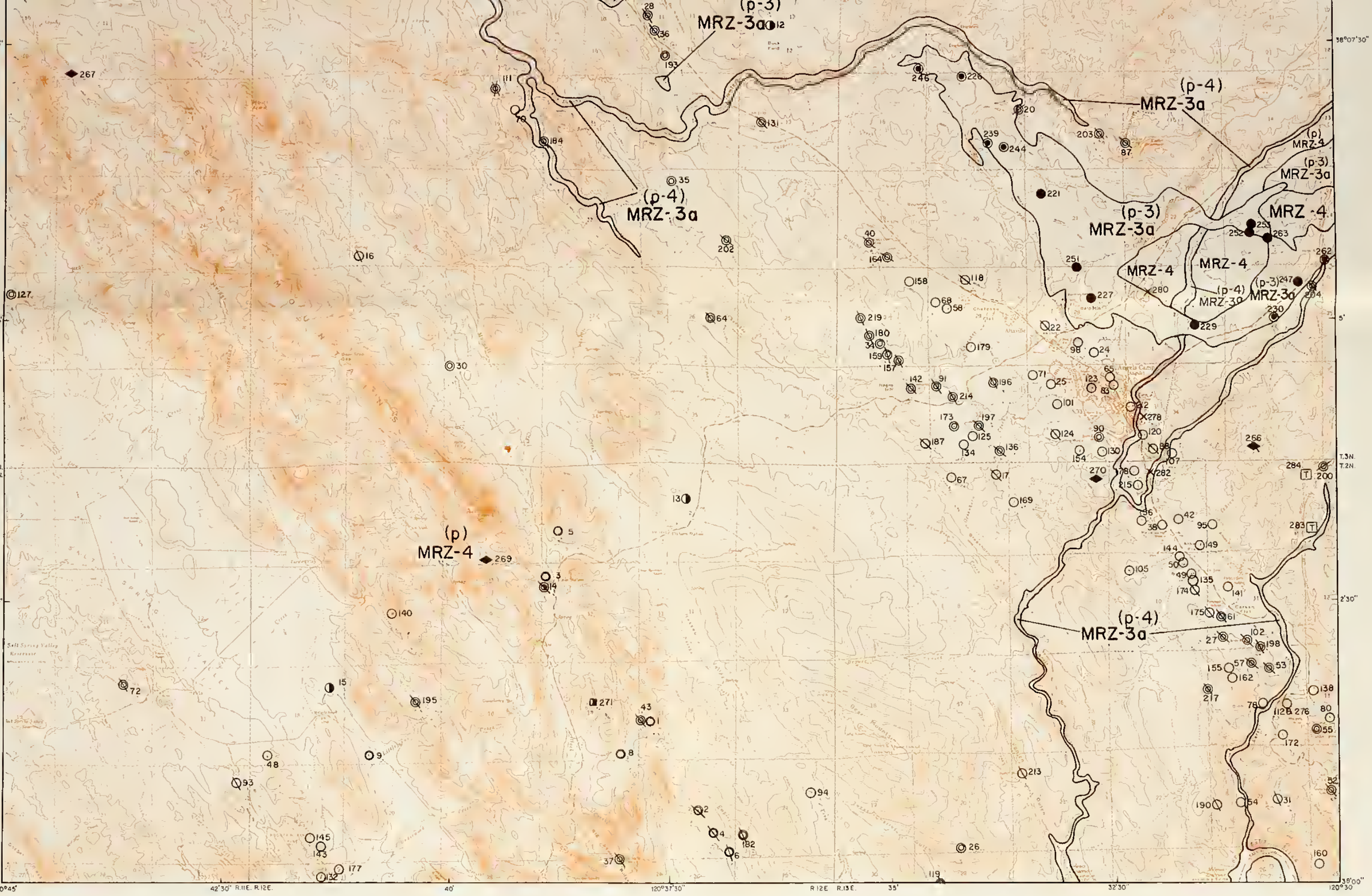
SPECIAL REPORT 169
MINERAL LAND CLASSIFICATION MAP - PLACER DEPOSITS
PLATE 6



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MINERAL LAND CLASSIFICATION MAP

SAN ANDREAS 15-MINUTE QUADRANGLE

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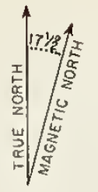
MAP LOCATION



DECLINATION

SCALE 1:48000

2 0 2 MILES

2000 0 2000 4000 6000 8000 10,000 12,000 14,000 FEET

2 1 0 2 KILOMETERS

MINERAL SYMBOLS

METALLIC	NON METALLIC
Copper	Asbestos
Gold, Lode	Carbonate Rock
Gold, Placer	Talc
Manganese	Silica
Chromite	
Iron	

Index Number (See Plate 1)

Trend of Deposit

MRZ-4 Mineral Resource Zone Boundaries. See mineral land classification criteria for resource zone (MRZ) definitions.

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

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Placer Deposits

MRZ-1[(p)]: Areas where geologic information indicates there is little likelihood for the presence of significant placer deposits.

MRZ-2a[(p)]: Areas containing alluvial deposits where geologic information indicates significant measured or indicated placer mineral resources are present.

MRZ-2b[(p)]: Areas containing alluvial deposits where geologic information indicates that significant inferred placer mineral resources are present.

MRZ-3a[(p)]: Areas underlain by alluvial deposits within which undiscovered placer mineral deposits similar to known placer deposits in the same producing district or region may be reasonably expected to exist (hypothetical resources). Such areas may include prospects of undetermined significance.

MRZ-3b[(p)]: Areas that may contain undiscovered placer mineral resources that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential (speculative resources).

MRZ-4[(p)]: Areas where geologic information does not rule out the presence or absence of placer deposits.

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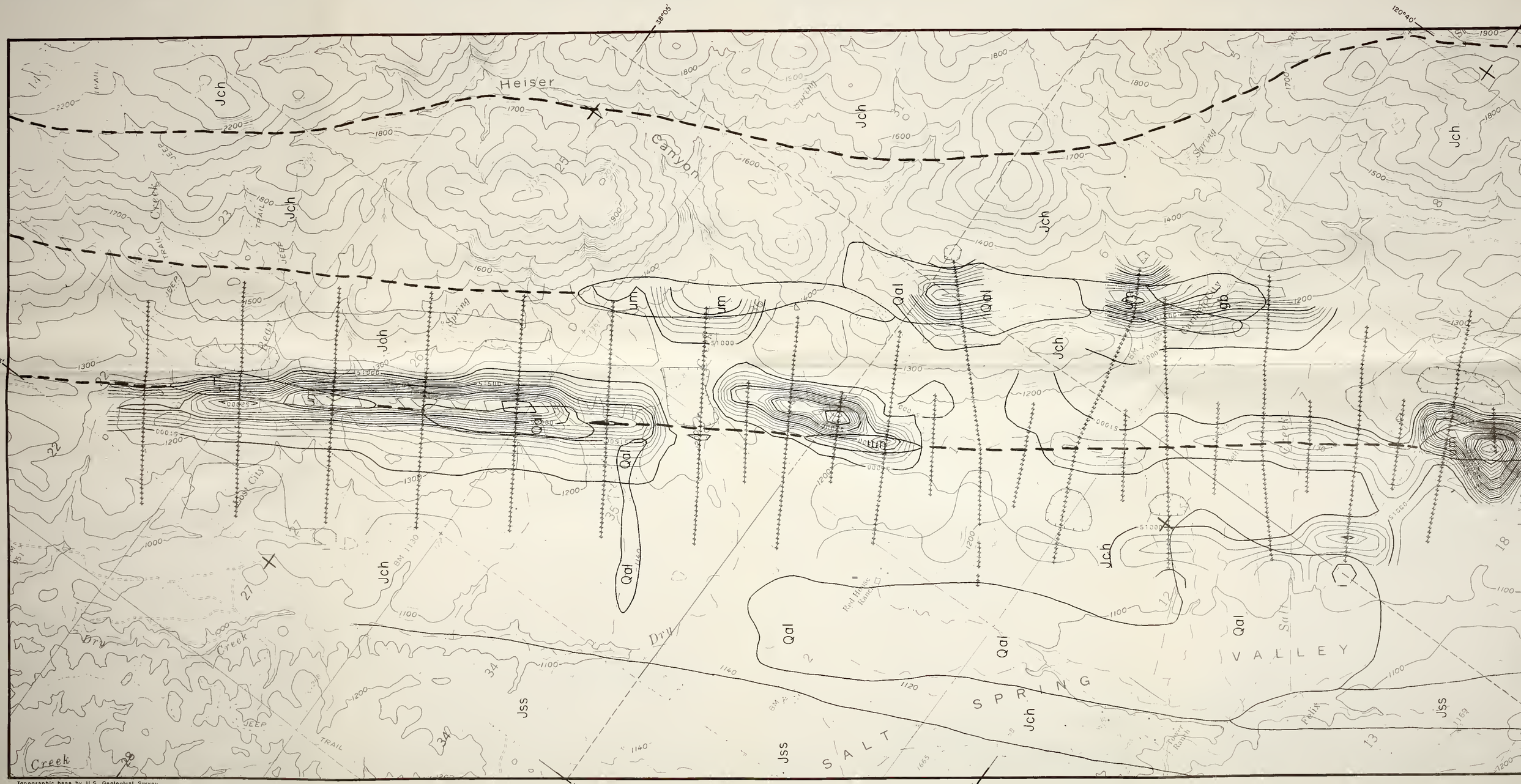

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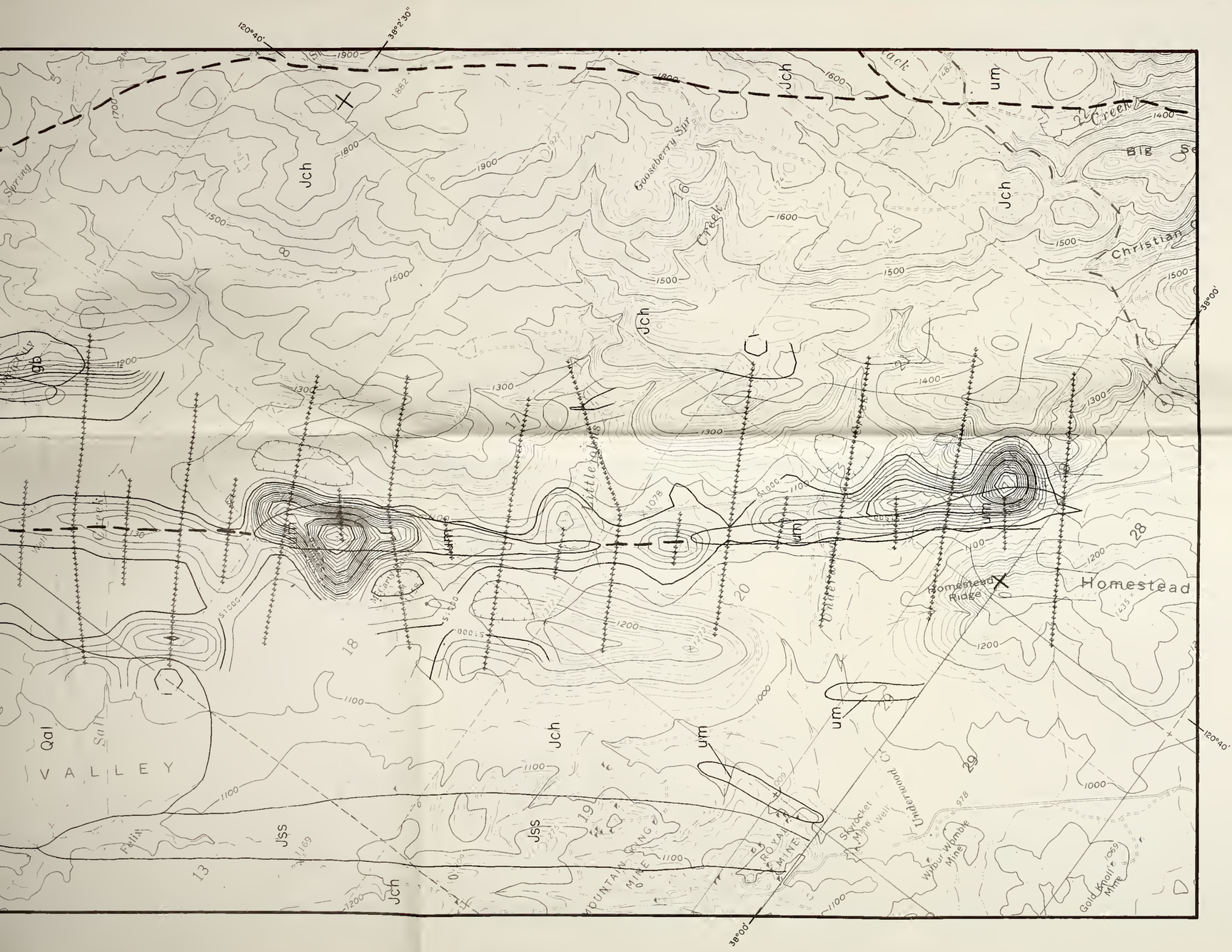
SPECIAL REPORT 169
SALT SPRING VALLEY AREA MAGNETIC SURVEY, CALAVERAS COUNTY, CALIFORNIA
PLATE 7


120°40'
38°02'30"
38°00'
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Gooseberry Creek
Big Sc
Christian C
Homestead Ridge
Homestead
Little Valley
Cutter Creek
Cutter Ridge
Cutter Flat
Tuttle Creek
Tuttle Ridge
Tuttle Flat
Tuttle Lake
Tuttle Lake Dam
Tuttle Lake Campground
Tuttle Lake Ranger Station
Tuttle Lake Resort
Tuttle Lake Cemetery
Tuttle Lake Airport
Tuttle Lake Mine
Tuttle Lake Mine Well
Tuttle Lake Mine Shaft
Tuttle Lake Mine Adit
Tuttle Lake Mine Dump
Tuttle Lake Mine Tailings
Tuttle Lake Mine Road
Tuttle Lake Mine Trail
Tuttle Lake Mine Cabin
Tuttle Lake Mine Ruins
Tuttle Lake Mine Equipment
Tuttle Lake Mine Machinery
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Tuttle Lake Mine Headframe
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Tuttle Lake Mine Generator
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Tuttle Lake Mine Electricity
Tuttle Lake Mine Fuel
Tuttle Lake Mine Transportation
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Tuttle Lake Mine Erosion
Tuttle Lake Mine Reclamation
Tuttle Lake Mine Revegetation
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Tuttle Lake Mine Violations
Tuttle Lake Mine Inspections
Tuttle Lake Mine Regulations